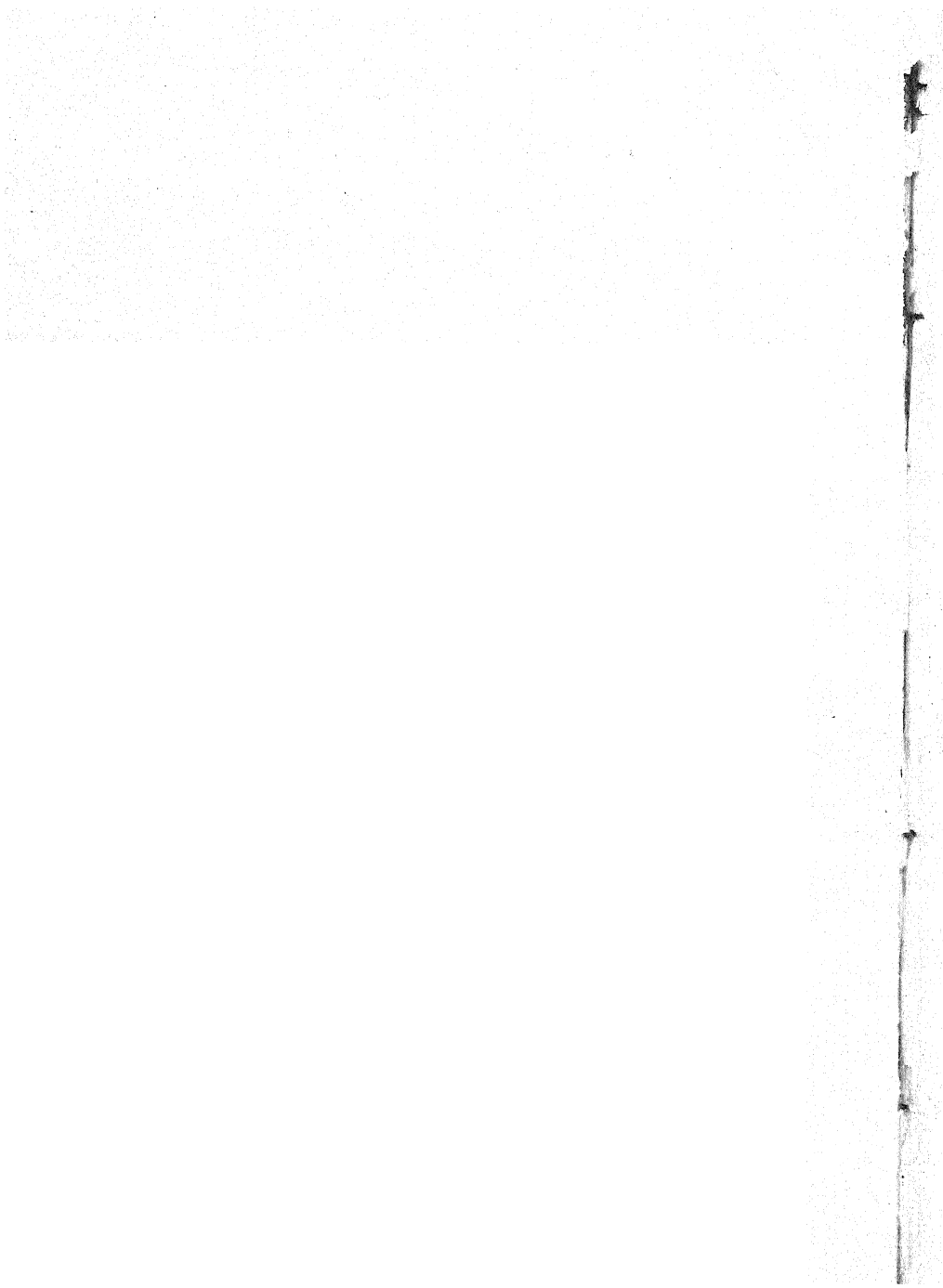


AGRICULTURAL LAND-USE IN PUNJAB

A Spatial Analysis



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A SPATIAL ANALYSIS

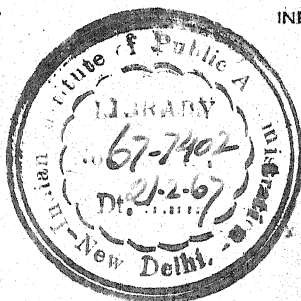
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P R E F A C E

This monograph on "Agricultural Land-Use in Punjab" is the outgrowth of the main work relating to the Socio-Economic Census Atlas of Punjab on which the authors worked in collaboration.

In the present stage of India's economic development, with planning effort severely conditioned by the staggering demographic situation, the role of agricultural planning can hardly be overemphasised. This study, with its emphasis on current land-use in Punjab and recent changes therein, brings out the interplay of economic and physical forces, besides the impact of a decade of conscious economic planning in the state.

The data used were collected under the personal supervision of the authors from the revenue records for each assessment circle in Punjab.

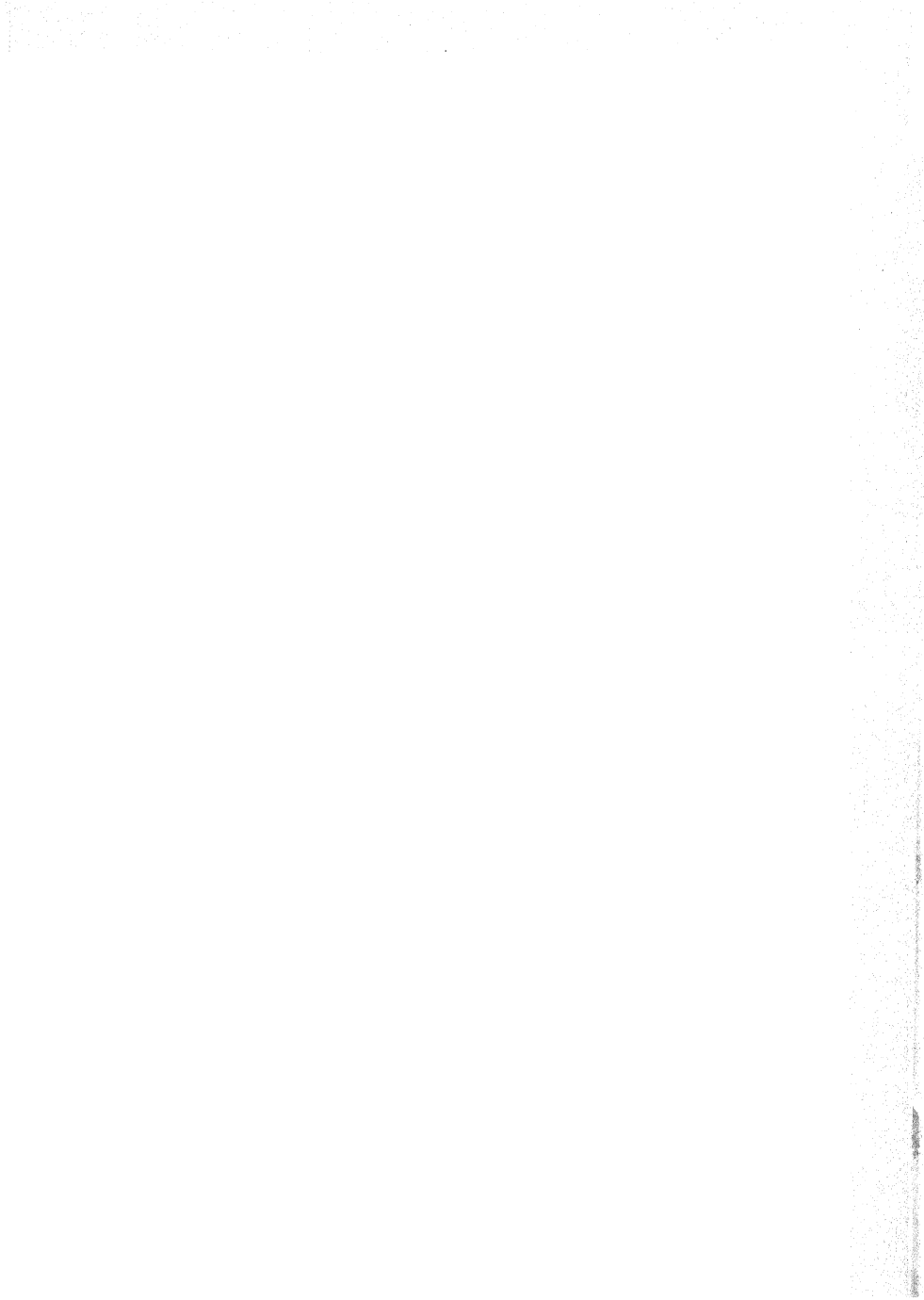
The cartographic representation of the data, besides facilitating analysis, has made it possible to see Punjab's agricultural land-use in the regional perspective.

It is hoped that the spatial approach followed in this study will provide a basis for adoption in regional agricultural planning.

The authors are grateful to the Superintendent, Census Operations, Punjab, for permitting the use of the data. They are grateful also to the Indian Institute of Public Administration, New Delhi, for undertaking its publication.

Chandigarh
December 28, 1966

GURDEV SINGH GOSAL
B. S. OJHA



AGRICULTURAL LAND-USE IN PUNJAB—A SPATIAL ANALYSIS

The patterns of agricultural land-use emerging in Punjab at present can be appreciated only in the context of its recent history. The western half of the pre-Partition Punjab was known as the granary of India, producing substantial surplus of foodgrains and non-food crops. It included a vast tract of fertile land having one of the best irrigation systems in the country. Agriculture in the canal colonies was more efficient, better organised and far more commercial than in most parts of India. The eastern half of the province, on the other hand, was lagging behind economically as well as socially.

With the Partition of India in 1947 not only was the "granary" lost to the country but also a break occurred in the tradition of progressive farming. Over three fourths of the canal irrigated area was left in West Pakistan. The eastern Punjab became a food-deficit state. Here, the irrigational facilities were incommensurate with the requirements; livestock were of poor breed; the peasants had not yet acquired the same progressive skill in farming as their counterparts in West Punjab; the level of literacy was low and urban development was meagre. However, one asset still available consisted of the enterprise and experience of the in-migrating peasantry, enlightened business communities and industrialists from West Punjab. The contact of these progressive farmers, businessmen and industrialists made a catalytic impact on the local population of the eastern Punjab. In fact, this situation has given an altogether new impetus to all the economic and social activities of the Punjabis. The result is that Punjab, as at present constituted, has not only become a surplus producer in foodgrains and several of the cash crops, but it has also made substantial progress in the field of industrial development. The remarkable achievement of the erstwhile food-deficit area comprising the present Punjab, inextricably as it is tied with the texture of the peasantry, is also the

outcome of a conscious policy of study, planning, development and promotion of extension work in the field of agriculture along with other fields which guided the endeavours and stimulated the spirits of farmers. Governmental activity consisted in implementing measures for consolidation of holdings, executing the Bhakra-Nangal Project and minor programmes to enlarge the coverage and intensity of irrigation, and promoting progressive farming by providing better quality seeds, fertilizers, insecticides and improved implements. It is indeed fascinating to look at the evolution of agricultural Punjab in perspective during the last fifteen years or so.

The purpose of this paper is to study the patterns of existing land-use with reference to the changes which have taken place during 1951-61. An understanding of the temporal-spatial variations in the use of the land will, it is hoped, provide a basis for future planning of agricultural development in the state.

The entire discussion in this study rests on what has emerged on fifty-six maps based on detailed data. Two types of maps have been prepared: (i) distribution maps; and (ii) ratio maps*. Data portrayed in these maps have been collected from Tahsil headquarters for each assessment circle—next to the village-level data, the assessment circle data provide the ultimate in detail for as large an area as 47,205 square miles forming the Punjab territory. Thus these maps would reveal patterns of land-use which are closest to reality. These patterns provide guidelines for formulating plans at local, regional and state levels. In all the maps three year average data have been centred on 1951 and 1961 respectively so as to eliminate the unusual features of a particular year.

Of Punjab's total population of 20,306,812 nearly 80 per cent live in villages. A little over 75 per cent of the rural working population is directly engaged in agriculture—66 per cent as cultivators and 9 per cent as agricultural labourers. From the

* The categories in the choropleth maps representing various type of ratios have been determined by keeping in view the state average and median values and also the critical break-points in the frequency graphs. This helps in obtaining a better appreciation of the areal variations in the ratios, particularly their deviation from the state averages.

viewpoint of occupational structure several other states of India are more predominantly agricultural than Punjab (Table 1).

TABLE 1

India : State-wise data on non-agricultural workers as per cent of total working force for rural areas, 1961.

<i>State</i>					<i>Per cent Non-agricultural Workers</i>
Kerala .. .. .	..	..	..	..	57.15
West Bengal .. .. .	..	..	..	..	28.35
Maharashtra .. .. .	..	..	..	..	27.22
Assam .. .. .	..	..	..	..	27.09
Punjab .. .. .	..	..	..	..	24.46
Andhra Pradesh .. .. .	..	..	..	..	24.13
Orissa .. .. .	..	..	..	..	22.48
Mysore .. .. .	..	..	..	..	18.99
Gujarat .. .. .	..	..	..	..	18.54
Bihar .. .. .	..	..	..	..	18.47
Uttar Pradesh .. .. .	..	..	..	..	17.02
Rajasthan .. .. .	..	..	..	..	14.97
Jammu & Kashmir .. .. .	..	..	..	..	14.78
Madras .. .. .	..	..	..	..	13.79
Madhya Pradesh .. .. .	..	..	..	..	13.48
INDIA .. .. .	..	..	..	..	20.78

Source : Calculated from Census of India Paper No. 1 of 1962, p. 443.

Land Utilisation in Punjab

From the mountain-locked valleys of Lahaul and Spiti down to the semi-arid area of the southern and south-western Punjab there is not a tract of land which does not bear the imprint of the farmer. Nearly two thirds of the total area is under cultivation (including the current fallow land which is about 4 per cent). If only the plain area is considered the proportion comes to about 75 per cent. Punjab shares this feature of a large percentage of the total area being under the plough with the entire Gangetic Plain where farming activity is ubiquitous. Only about 3 per

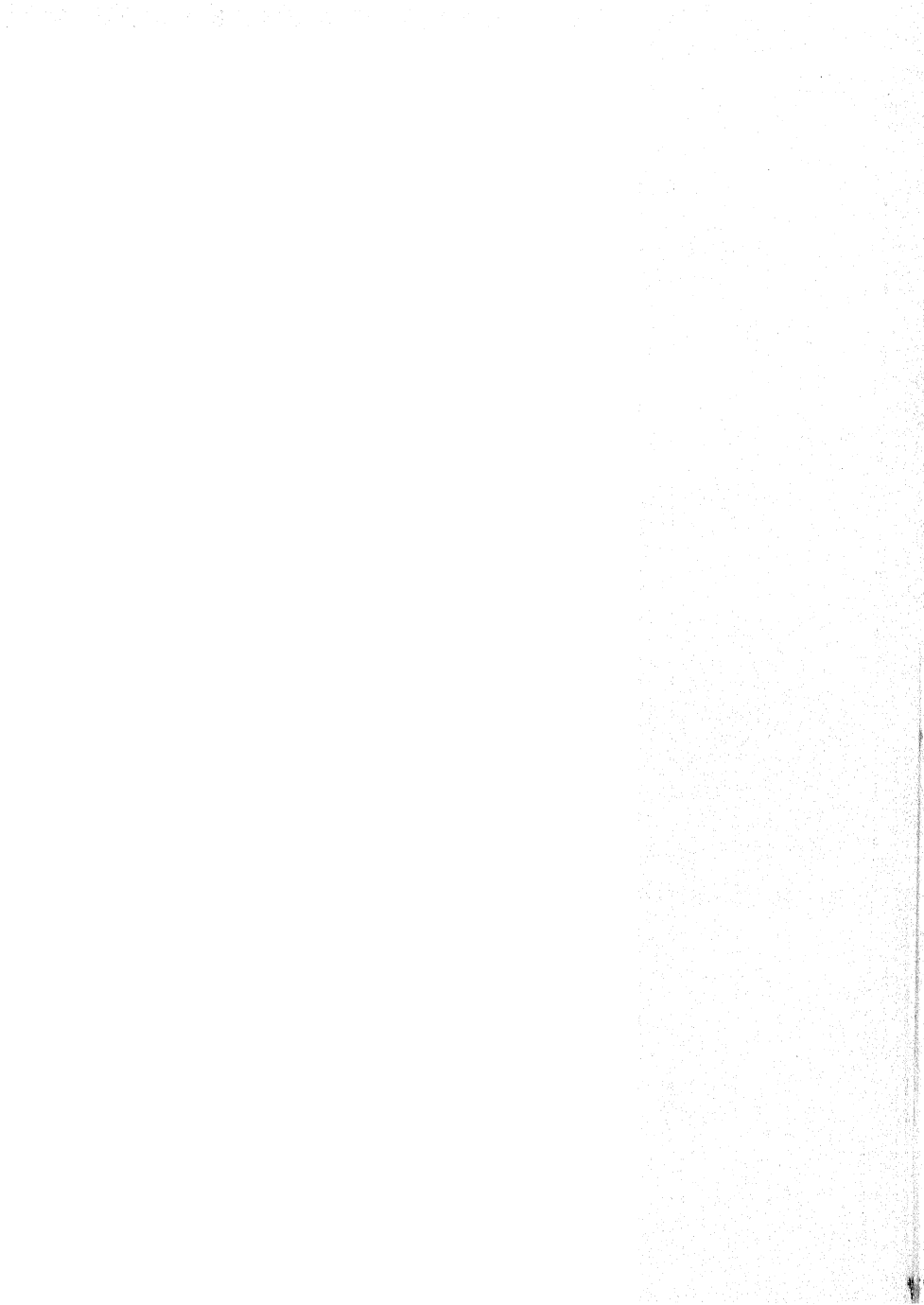
cent of the total area of the state is under forests which are confined, almost exclusively, to the mountains where steep slopes and rocky surfaces do not easily lend themselves to be pierced by the keen blade of the farmer's plough. About 27 per cent of the Punjab's area is partly under non-agricultural uses and partly unfit for cultivation, and thus not available for farming. The non-agricultural uses include settlements, roads, railways, canals etc. The culturable wastelands are only 5 per cent of the total area. These are really marginal lands some of which are suffering from arid conditions, some from too much of water, some from soil erosion while some could not be cultivated for other reasons. These could be brought under the plough by following a carefully planned programme of development of irrigation, prevention of soil erosion, and drainage of wet lands. In these major classes of land utilisation, however, there are significant areal variations as revealed by the maps.

Net Sown Area

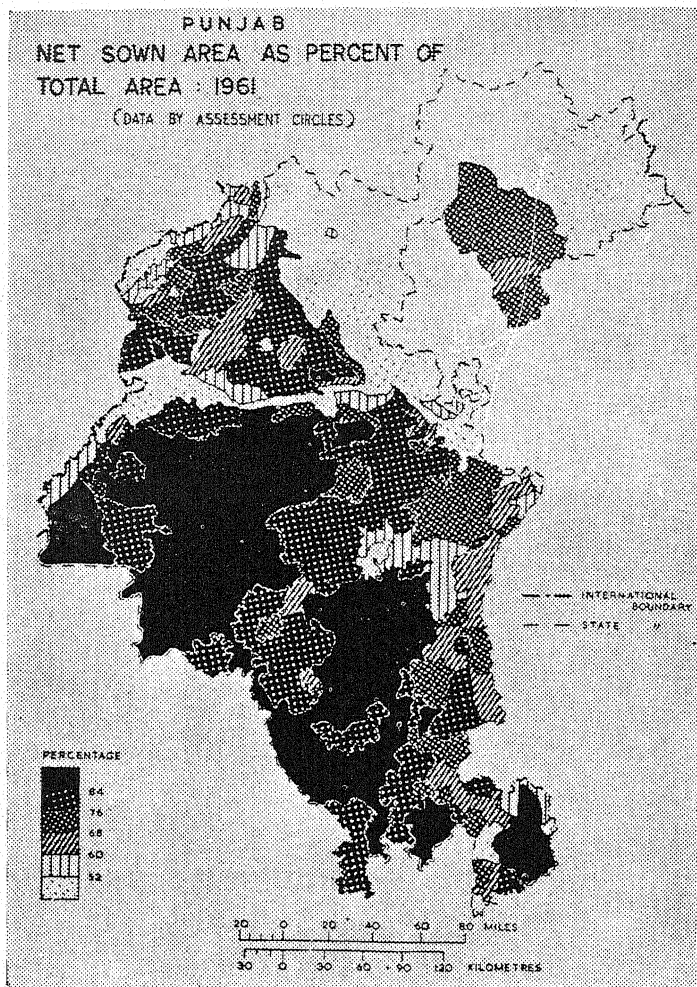
With an addition of over two million acres to the cultivated land during the decade 1951-61, the proportion of net sown area to total area increased from 54 to 61 per cent; yet the per capita net sown area has declined from 1.04 acres in 1951 to 0.9 acre in 1961. This is because of the staggering increase in population during these years (Map 1).

The proportion of net sown acreage varies from area to area (Map 2). In the mountainous districts of Simla, Kangra and Lahaul and Spiti where rough terrain, short growing season at high altitudes, and rocky surfaces are typical, the proportion of net sown area is very low. In the Lahaul and Spiti district it is not even one per cent, while in the Simla district it is about 16 per cent. In several assessment circles in the Kangra district it is less than 10 per cent. Cultivation in these areas is confined to river valleys and gentle terraced slopes. In the lower hills in the Kangra district the proportion is larger but mostly below 30 per cent. In the cho-infested and partially hilly circles of the foothill districts of Ambala, Hoshiarpur and Gurdaspur also the proportion of net sown area is generally below 40 per cent. Cultivation is also restricted in the floodplains (*bets*) of the Yamuna, Sutlej, Beas and Ravi rivers where too much of water





during the kharif season is the chief deterrent. A lot of arable land in the *bets* of the Sutlej and Beas rivers has been reclaimed during 1951-61, increasing the cultivated area substantially (Map 3). Lastly the percentage of net sown area is still relatively low (lower than 60 per cent) in parts of the Patiala and Karnal districts where extensive areas have till recently been lying waste



MAP 2

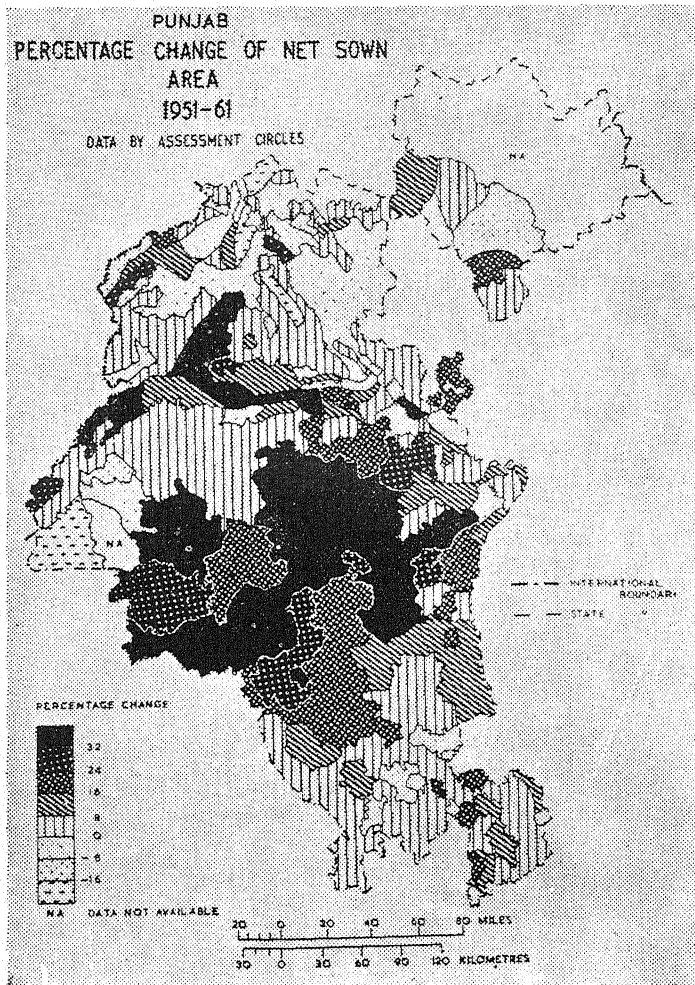
for social and political reasons. In both of these areas a lot of new settlement has taken place in recent years following the development of canal and tube-well irrigation (Map 3). In the Powad, Naili and Indrawar assessment circles of the Kaithal tahsil and the Nardak circles of the Karnal tahsil there is still considerable scope for extension of agriculture.

In contrast to the above areas, cultivation is all pervasive in the upland plains often covering more than 76 per cent of the total area. It is interesting to note that the highest proportion, exceeding even 84 per cent, is found in the arid and semi-arid areas of southern and south-western Punjab where facilities for irrigation are lacking. These are the areas where the pattern and intensity of sowing follows unmistakably the quantum and pattern of rainfall because the only insurance against starvation is the extension of sowing over as large an area as possible. This is, incidentally, not an isolated feature peculiar only to Punjab but fits in the All-India pattern of arid and semi-arid areas having unusually high proportion of net sown area.

The proportion of cultivated acreage is also equally high in those areas where rainfall is adequate, irrigational facilities from canals, tube-wells and wells are well developed, and the land is flat and free from hindrances so that returns from cultivation are certain. In the north-east to south-west extending belt of central Punjab there has been an impressive increase in the cultivated area during 1951-61 following the release of extra cultivable wastelands from the landlords in the erstwhile princely states of PEPSU and with the extension of canal irrigation from the Bhakra-Nangal Project (Map 3).

There are scattered patches of land where the net sown area suffered decrease during the last decade due either to encroachment on agricultural land by non-agricultural uses—such as expansion of settlements, roads, railways, canals, etc.—or to water-logging as in parts of the Amritsar, Gurdaspur, and Rohtak districts.

The comparatively high percentage of net sown area in the Kulu region as it emerges on the map is misleading. The proportion is quite low in fact. The cadastrally unsurveyed area



MAP 3

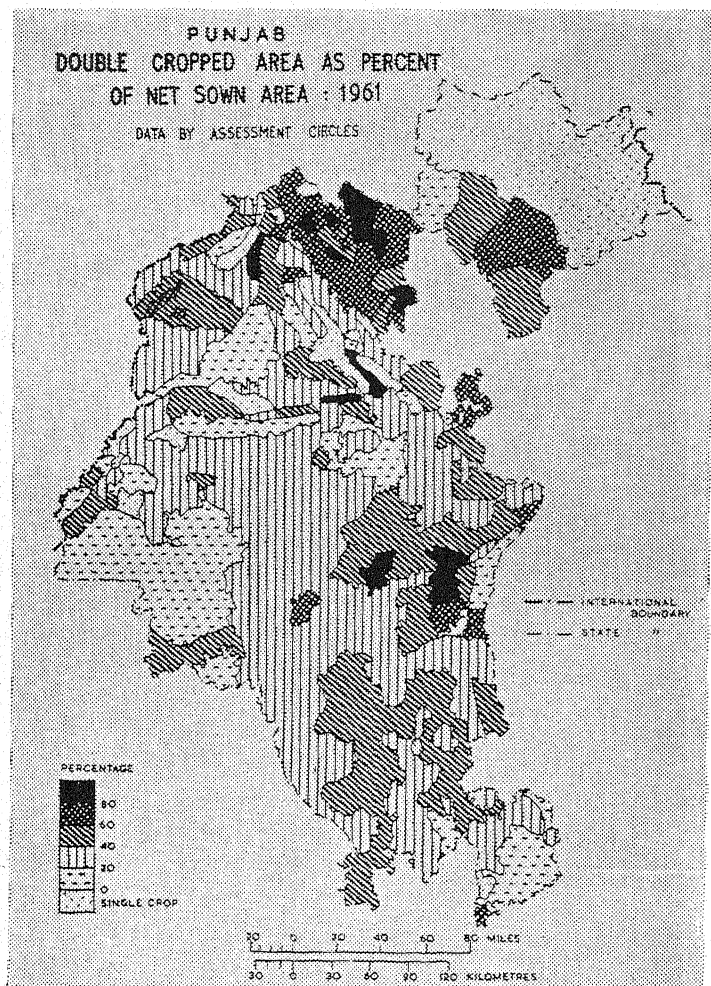
which is a substantial proportion of the total land is not included in the data maintained in the revenue records.

Double Cropped Area

In Punjab 30 per cent of the net sown area in 1961 was double cropped, as compared to 18 per cent in 1951. This increase is

attributed to various measures among which extension of irrigation is the most important. Practically everywhere in the state some increase in double cropped area has been experienced during the period of the first two five-year plans.

In the hilly and lower mountainous regions receiving abundant precipitation, more than 60 per cent of the net sown area is



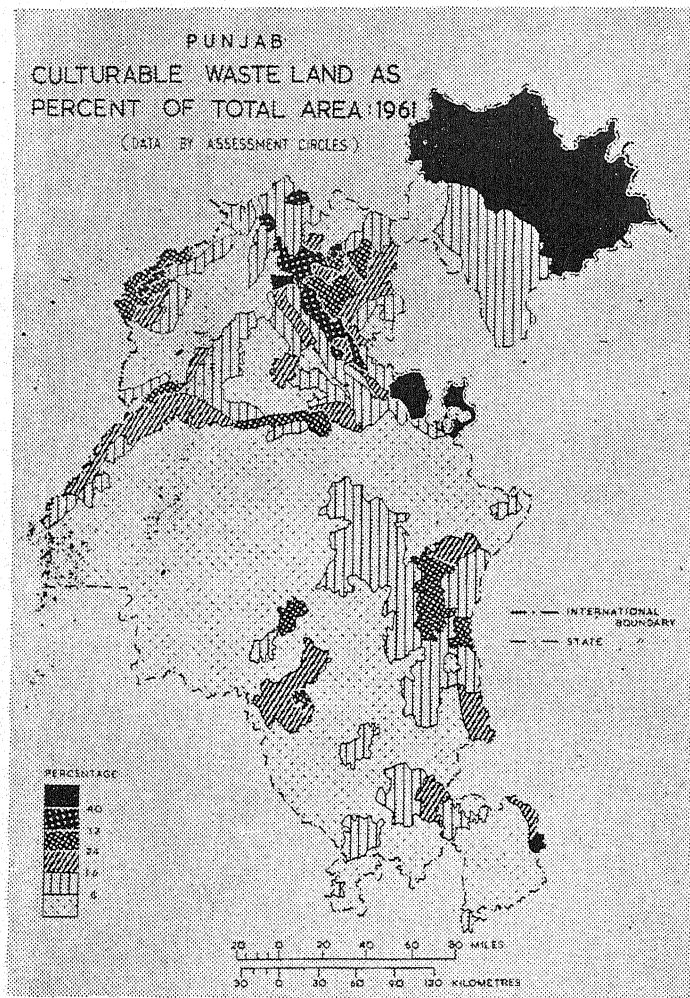
MAP 4

double cropped (Map 4). Similarly in the newly reclaimed areas of the Karnal and Patiala districts the proportion of double cropped area far exceeds 40 per cent. But in most of the remaining plain area the proportion ranges between 20 and 40 per cent. In some of the southern and south-western parts of the state, as also in several of the floodplains, it is even less than 20 per cent. The Lahaul and Spiti district, where the growing season is short and the terrain is rough, is the only large area where double cropping is not possible at all. What is apparently most surprising is that even in the canal irrigated areas of the central and south-western Punjab, acreage under double-cropping is small. It reveals how the supply of canal water for irrigation during both the crop seasons is still inadequate. In the northern part of the Punjab Plain where annual rainfall ranges between 25 and 35 inches and where water-table is generally within easy reach, further extension in well and tube-well irrigation can help in increasing double cropped acreage. It may, however, be pointed out that in most parts of Punjab two crops are often grown simultaneously by inter-culture methods. The second crop is generally a minor pulse or an oilseed crop.

Culturable Wasteland

In a region where for ages cultivation has been the most important economic activity of the people and where more recently, the pressure of population on land has increased, one would *a priori* expect the absence of any sizable wasteland. The culturable wasteland in Punjab is indeed only about 5 per cent of the total area. However, in parts of the Karnal and Patiala districts the percentage of wasteland ranges between 8 and 32. It is the highest in some of the Nardak areas of the Karnal district. The proportion is also high in the *bets* of the Yamuna, Sutlej, Beas and Ravi rivers (Map 5). Cultivation is being extended gradually in both types of wastelands with the help of irrigation and drainage respectively. Everywhere else in the plains culturable wasteland is very little and that too is confined to the village common lands.

In the hilly and mountainous areas the percentage of wasteland is high but its utilisation (which is impossible without terracing) is not worth the effort.



MAP 5

It would thus appear that agricultural frontiers have reached their outermost limits and there is not much scope for increasing the cultivated area. Intensification and diversification* of

* The term is used here to connote the development of poultry, piggy, dairy, etc. as supplementary sources of agricultural production.

agriculture in the land which is already under the plough are the only promising measures for increasing agricultural production.

Land not Available for Cultivation

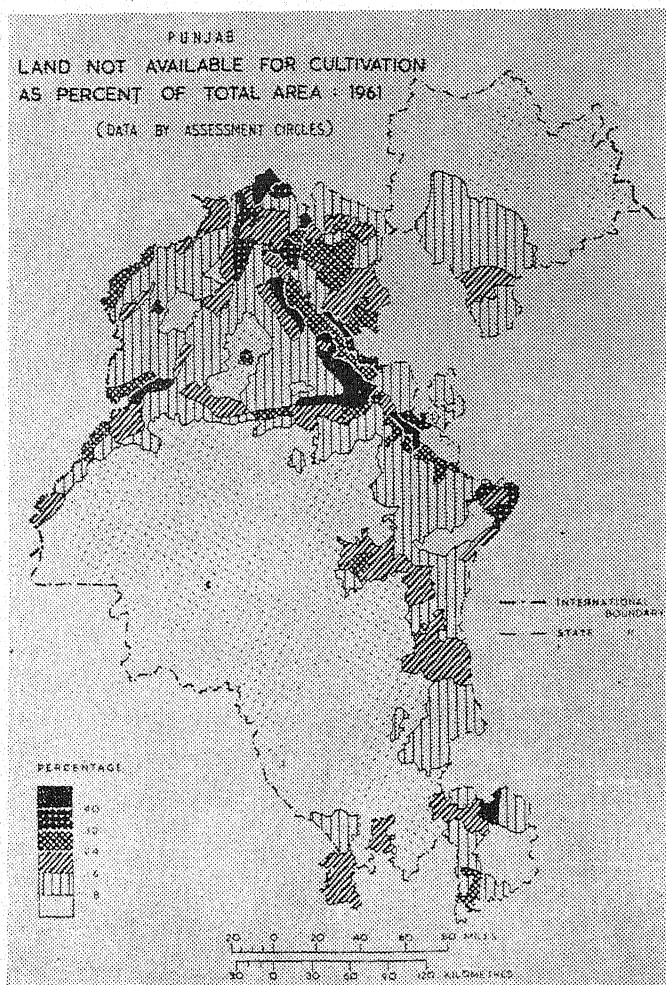
About 27 per cent of Punjab's area belongs to this category. Whereas nearly four fifths of this area is not fit for cultivation, one-fifth is under non-agricultural uses. It is significant to note that with the expansion of towns, growth of rural settlements, construction of new roads, canals etc., the area under non-agricultural uses in the state has increased from 1·1 million acres in 1951 to 1·8 million acres in 1961. This increase is mostly at the cost of good agricultural land which must be spared for food production in view of the increasingly alarming demographic situation. It reminds one of the need of a land-utilisation survey which may become the basis of future land-use planning whereby the growing demand on land for non-agricultural purposes may be met but without any encroachment on good farm land.

The distribution of land not available for cultivation is asymmetrical (Map 6). Areas where the proportion of such land is high are: (i) the relatively highly urbanised eastern and northern sections of the Punjab Plain; (ii) riverine tracts which are too wet for cultivation; (iii) water-logged localities; and (iv) tracts where slopes are too steep for farming.

Current Fallow Land

It denotes cultivable land left uncultivated during the current year. Fallowing is practised mainly to enable the land to recuperate. Fallowing also becomes necessary under too wet or too dry conditions when no crops can be sown. Current fallow land has declined from nearly 9 per cent of the total area in 1951 to about 4 per cent in 1961, due chiefly to extension of irrigation to dry and semi-dry areas, reclamation of poorly drained lands, and improvement of cultivated lands. Continuation of these measures can further reduce the proportion of fallow land. A scientific system of crop-rotation and dry-farming can also be instrumental in obviating the practice of fallowing.

The distribution of current fallow land in Punjab is very uneven. Generally they are found marginal to areas classified as



MAP 6

“not fit for cultivation”. The highest proportion is found in the floodplains of the Yamuna, Ghaggar, Sutlej, Beas and Ravi rivers where 10 to 20 per cent of the total area comprises current fallow land. By introducing cultivated grasses and evolving a suitable rotation of crops much of the current fallow land in

these *bets* can be brought under permanent cultivation. These areas are suitable for developing commercial dairy farming.

Forests

In Punjab only about 3 per cent of the total area is under forests. In the plains where pressure of population is acute and search for cultivable land is keen, real forests are absent. They are almost exclusively confined to those hilly and mountainous areas where precipitation is adequate but slopes are too steep for cultivation. Forests of commercial use are found only in the upper reaches of the Kangra and Simla districts.

From the preceding discussion some important points may be clearly set forth. The net sown area dominates the broad pattern of land-use in Punjab and will continue to do so. Areas under current fallow and culturable waste are rather small and their reclamation will only be slow. On the other hand, "area not available for cultivation" is likely to expand with increasing industrial development, growing towns and villages, and construction of new roads and canals. Thus gains in cultivated area resulting from reclamation of waste and fallow lands are likely to be neutralised by increases in areas under non-agricultural uses, water-logging and soil erosion. Moreover, the land which is currently lost to agriculture is usually of high grade, while that being reclaimed is of low to medium quality. This necessitates a thorough land utilisation survey of the state so that the development of non-agricultural uses may in future be restricted to areas which are of low grade from the agricultural viewpoint, and to spare every inch of the superior quality farm land for agricultural production. It must be emphasised, therefore, that intensification and diversification rather than extension of agriculture should be the central theme of our agricultural planning. At the same time we should aim at the physical improvement of land already under the plough. This can be done through: (i) extension and improvement of irrigation systems; (ii) improvement of drainage; (iii) repair of land which has been physically damaged; (iv) control of soil erosion; and (v) consolidation of land holdings (which is already progressing very satisfactorily).

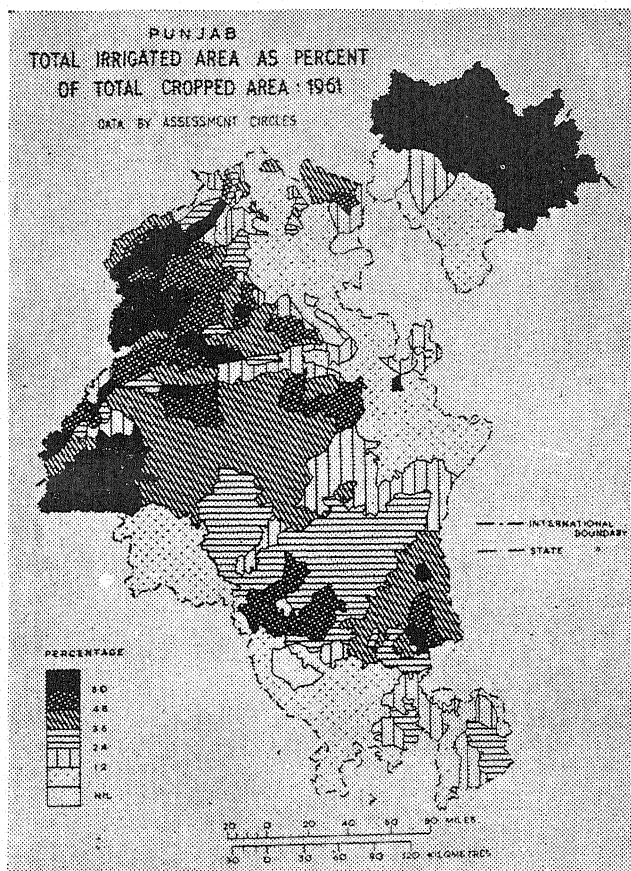
Irrigation

What must be emphasised at the outset is not simply the need but the imperative character of irrigation in Punjab. Here, as in fact in many parts of India, precipitation is the most crucial factor in agriculture. The growing season extends practically over the entire year. The rainfall depends on the intensity of the monsoon air flow, and deviations from its annual mean values are large. At the same time the dry and wet seasons are so well defined that a delay of only a week or so in the break of the monsoon has to be considered a major climatic hazard. The development of irrigation, even in areas which apparently have adequate rainfall, is therefore a pre-requisite for the stabilisation of the agricultural economy.

In 1961, about 40 per cent of the total cropped area in Punjab was irrigated, the percentage, however, varied from less than 12 to over 60 in different areas (Map 7).

Throughout the foot-hill zone of the Ambala, Hoshiarpur, and Gurdaspur districts, less than 12 per cent of the total cropped area is irrigated and many of the crops do not receive any irrigation at all. This is so partly because the entire belt receives over 30 inches of rainfall annually so that only supplemental irrigation is required for helping certain crops to mature successfully, and partly because there are difficulties in the way of developing irrigation. These difficulties include deep water-table and insufficient quantity of water in the substrata. For canal irrigation these areas are much too undulating and much above the water level in canals. In the southern and south-western fringes of the state also the development of irrigation is meagre. In the floodplains of the Yamuna, Sutlej and Ravi rivers too irrigation is not much needed.

Leaving apart the peripheral areas on the north, south and south-west, the remaining Punjab Plain is distinctly divisible into two contrasting regions with respect to irrigation. While in the western half almost everywhere 36 to over 60 per cent of the total cropped area is irrigated, the corresponding proportion remains below 36 per cent in a major portion of its eastern



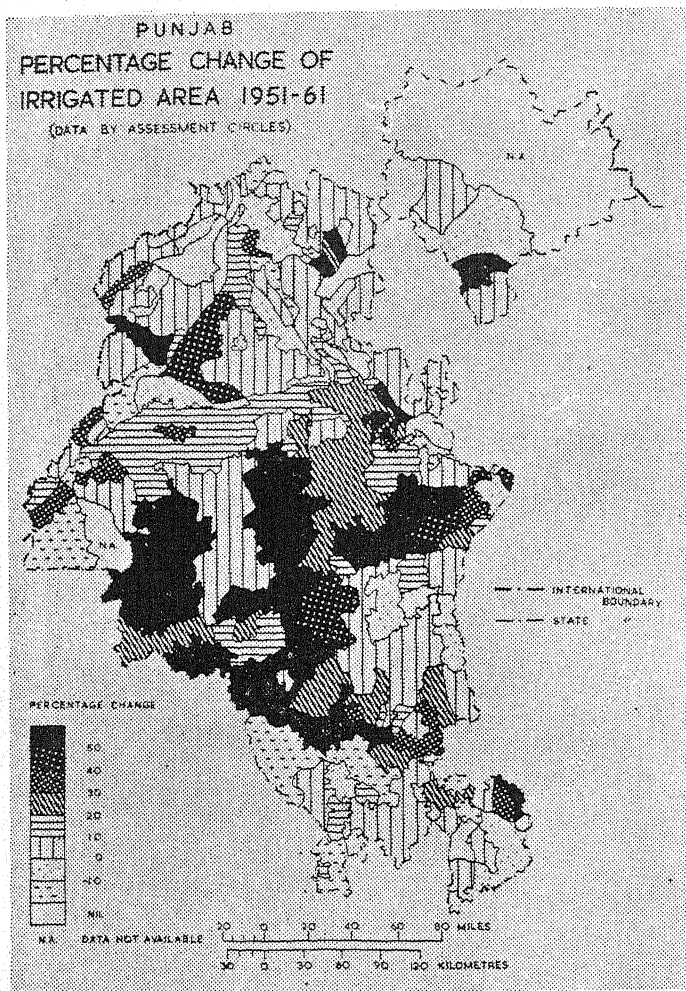
MAP 7

counterpart. This is despite the remarkable development in irrigation in this area during the last decade (Map 8).

It may be noted here that the rainfall conditions in the two areas do not differ very much. It reveals the scope of additional effort that still remains to be made in the eastern region to stimulate its agricultural development.

Percentage Change of Irrigated Area : 1951-61

In spite of a net increase in the gross irrigated area by over 2 million acres during the decade, there is no increase in the



MAP 8

proportion of irrigated area to total cropped area of the state. This is due partly to the reclamation of land which is not irrigated and partly to the loss of irrigated land to non-agricultural purposes and water-logging. Significant increase in irrigated area has taken place only where new canals have reached. However, even in many of the canal irrigated areas water is available

neither according to full requirements nor over the entire year. Consequently the percentage of double cropped area to area irrigated is not as high as it could be. Thus there is a genuine need for further extension and intensification of canal irrigation in the southern and south-western areas of Punjab.

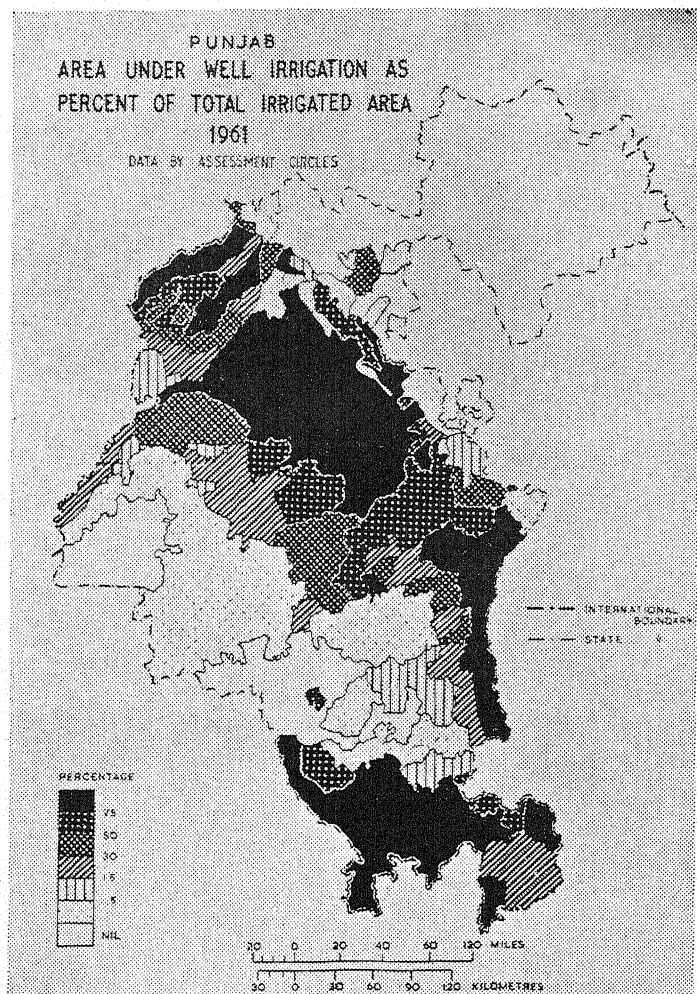
Sources of Irrigation

Well Irrigation—Well irrigation in Punjab is very old. Almost a third of the net area under irrigation is irrigated from wells. The bullocks and camels provide the main source of power for running the Persian wheel. However in recent years pumping sets run by diesel oil and hydro-electric power have replaced the traditional sources of energy in several areas,

Well irrigation is concentrated in the northern half of the Punjab Plain where over extensive areas more than 75 per cent of the irrigation is done from wells. In this belt annual rainfall generally exceeds 25 inches, water-table is well within 30 feet and quantum of water in the substratum is adequate, except in the narrow belt immediately in the foot of the Siwaliks, stimulating the development of well irrigation. In the Mahendragarh and Gurgaon districts facilities for irrigation are meagre, but whatever area is under irrigation is commanded by wells in the basins between the hills. In the southern half of the Punjab Plain, on the other hand, rainfall is much low, ranging between 10 and 25 inches, and is highly variable. Here water-table is too deep for well irrigation; quantity of water in the substratum is inadequate; and the water is brackish in many areas. As a result, well irrigation is practically absent (Map 9).

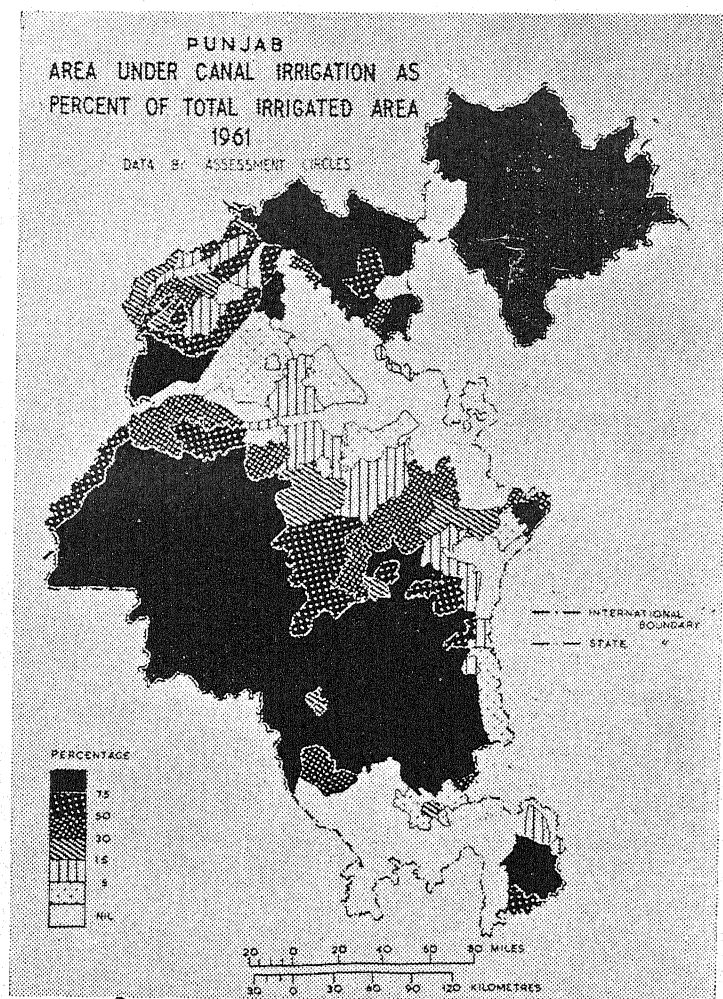
Canal Irrigation—About two thirds of the net area under irrigation is commanded by canals. The distributional pattern of canal irrigation is complementary to that of well irrigation (Map 10).

Canal irrigation is largely meant for the dry and semi-dry areas of the southern Punjab Plain where well irrigation, or any other type, is not possible. Moreover, in this belt water from the canals flows into the fields under the force of gravity and nowhere is pumping necessary. In the northern belt, on the



MAP 9

other hand, the level of canal water is lower than that of the adjoining fields, making pumping necessary particularly in the undulating foot-hill zone which makes irrigation costly. Because of the greater irrigational needs of the dry areas in the south and also because of the existence of alternative methods of irrigation in the north, area irrigated from canals in the northern

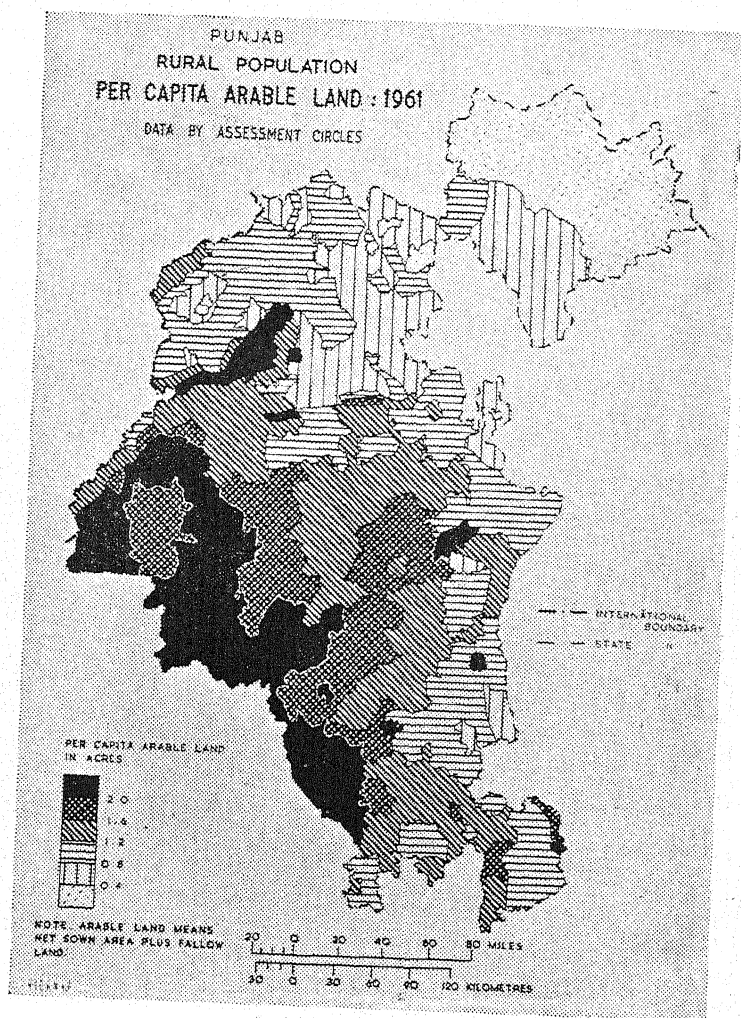


MAP 10

Punjab Plain is only a small proportion of the total irrigated area. In order to achieve higher agricultural efficiency throughout Punjab it appears desirable to spare canal water exclusively for the dry and semi-dry areas of the southern half of the Punjab Plain, and to concentrate on the development of well and tube-well irrigation in the northern half.

Per Capita Arable Land

In rural Punjab the per capita arable land (net sown area plus fallow land) comes to about 1.2 acres. It is the lowest (.3 acre) in the Lahaul and Spiti district where cultivation is possible only along river valleys. In the mountainous districts



MAP 11

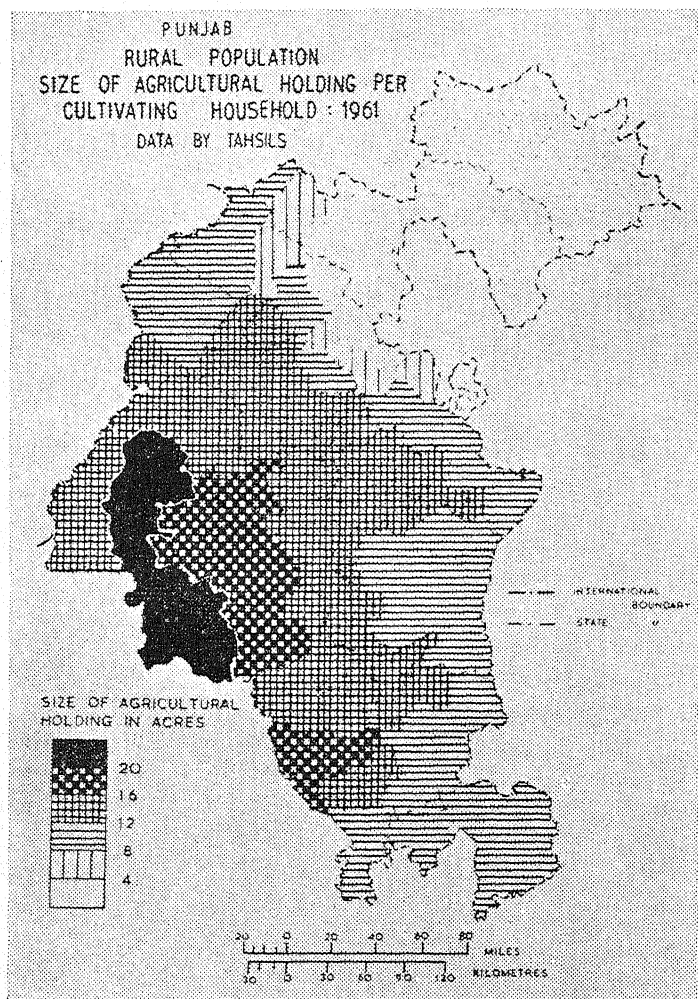
of Simla and Kangra it is between .4 and .8. In large parts of the Hoshiarpur district where a considerable proportion of the land has been severely damaged by *chos*, the per capita arable land is generally less than .8 acre. So is the case in the densely populated Jullundur district. In the plain area of the state there is a gradual increase in per capita arable land to the south-west in inverse proportion to decrease in rainfall so that in the peripheral areas it exceeds 2 acres (Map 11). It may, however, be mentioned that apart from the quality of soils and amount of rainfall, social and political factors also come in the interpretation of areal variations in the per capita arable land.

Size of Agricultural holding per Cultivating Household

In Punjab the size of agricultural holding per cultivating household ranges between 1.5 acres in the Spiti tahsil and 25.2 acres in the Sirsa tahsil (Map 12). In the mountainous districts of Simla and Kangra and also in the hilly Una tahsil, the average land-holding is less than 4 acres. In the plains there is a gradual increase in the size of holdings in inverse relation to decrease in rainfall. However, the size of an agricultural land-holding is a complex phenomenon and cannot be explained in terms of environmental factors only, important though they are. Much depends also on how the land was distributed at the time of settlement and the changes which took place subsequently as a result of social and economic reforms and other related events. Due to the continuing direct dependence of a large majority of the working force on agriculture and the rapidly growing population, the size of agricultural holdings is decreasing. In fact, a large proportion of the holdings are already uneconomic in size. Not only is it desirable to divert a large proportion of the population from farming, but also it is equally necessary to intensify and diversify agriculture at each farm.

Patterns of Utilisation of the Cropped Land

With 72.5 per cent of the total cropped area devoted to food crops (as against 76 per cent in India), Punjab closely represents the average pattern of utilisation of cropped land in the country. However, in West Bengal, Bihar and Uttar Pradesh, where pressure



MAP 12

on farm land is severe, 88, 88 and 82 per cent of the cropped area respectively is devoted to food crops. In arid and semi-arid Rajasthan the corresponding proportion comes to 84 per cent. As in Maharashtra and Gujarat, cash crops occupy a fairly significant place in Punjab's agricultural land-use. However, as a result of the fast growing population and improving levels of

consumption in Punjab, the area under food crops has increased by about 30 per cent during 1951-61. Within the state, patterns of distribution of various crops and their significance in relation to total cultivated area vary from region to region. In order to have an integrated view of the agricultural land-use in the state as a whole and in its constituent parts it is relevant to analyse the patterns of individual crops.

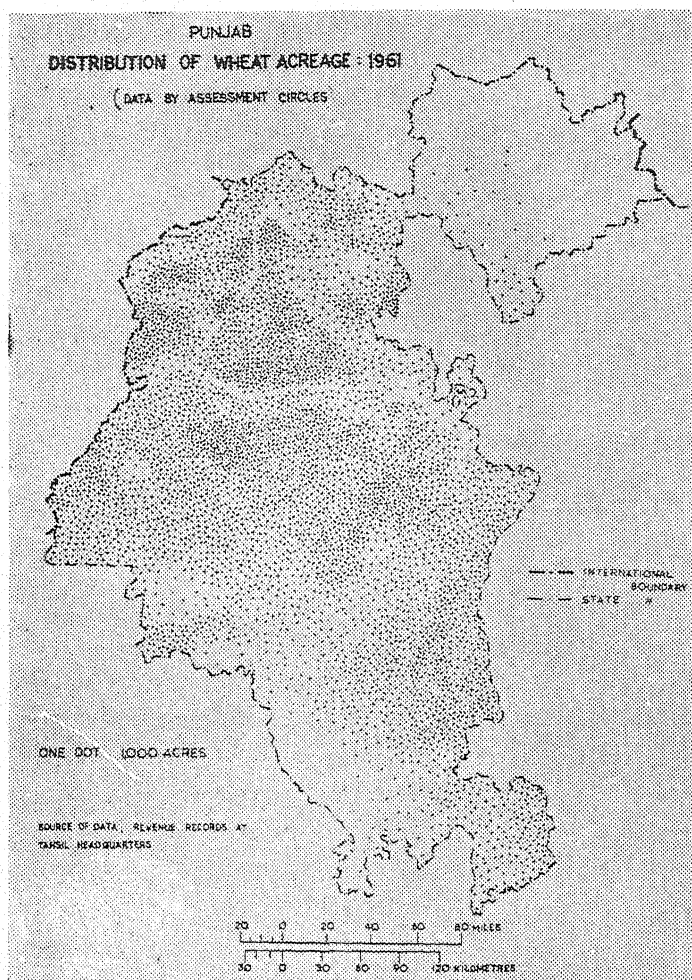
Broad regional variations in the relative concentration of crops are related to land-forms, temperature conditions, rainfall, soils, adequacy of irrigational facilities, and economic factors. Variations within small localities (such as a village), however, are explicable in terms of slopes of individual fields, local drainage, micro-climatic differences and local soil types, in addition to such cultural factors as tradition, man's ability, and choice in the use of land, which frequently represent his individual reaction to the physical and economic environment.

Crop Seasons

In Punjab there are two crop seasons: *kharif* and *rabi*. The *kharif* season coincides with the rainy season. The *kharif* crops are sown with the onset of the summer monsoon in July, and are harvested in the latter part of September and early October. The *rabi* crops are sown in late October or early November, and harvested in April.

Wheat

Accounting for 22.5 per cent of the total cropped area (as against 9 per cent in India as a whole), wheat is the leading food crop in Punjab. It is the most important *rabi* crop and is sown a few weeks after the retreat of the summer monsoons, generally in early November. At that time the soil is most easily worked and sufficient moisture is usually present to foster growth until the light winter showers. In spite of extensive irrigation development, the size of the crop still depends largely on the vagaries of the monsoon rains. The proportion of wheat acreage decreases progressively eastward in the Indo-Gangetic Plain and thus is inversely correlated with that of rice. Conditions of temperature and rainfall during the winter season, it is to be noted, are



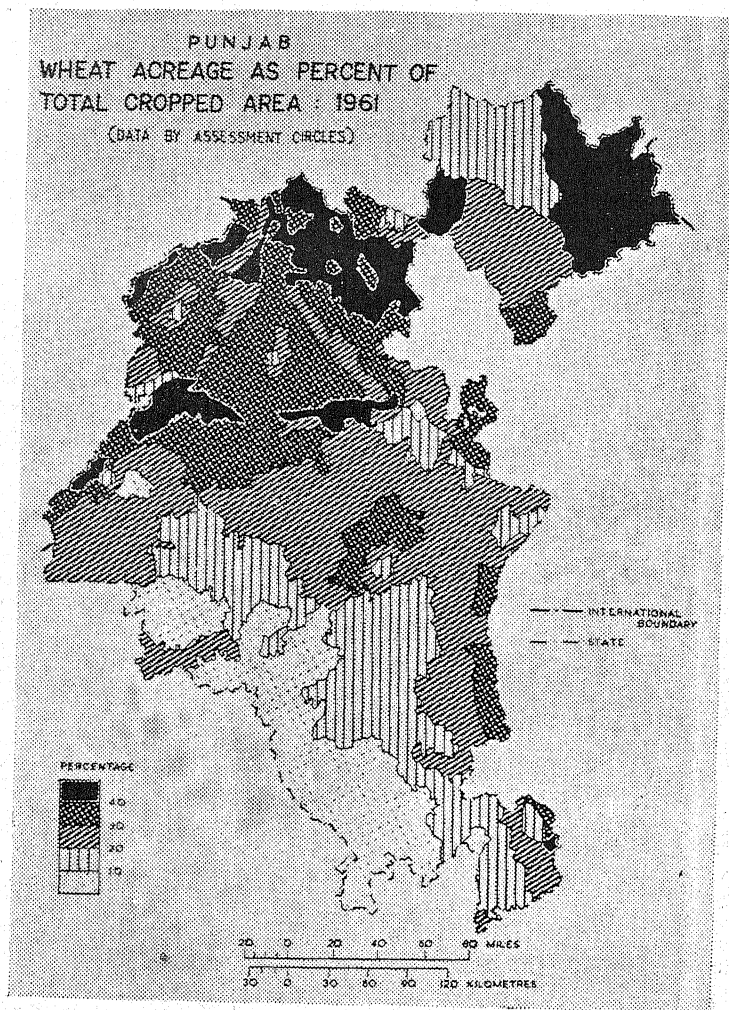
MAP 13

really the governing factors in wheat cultivation in this large tract.

In Punjab wheat is one of the most widely grown crops. Its concentration is the greatest, however, in the north-eastern, central and north-western parts of the state's plain area (Map 13). Its distribution becomes sparse toward the south-west. Though

the actual acreage of the crop in the mountainous regions is small, its relative importance with respect to the total cropped area is great (Map 14).

In the Bist and Upper Bari *doabs* and in the lower Sutlej tract wheat acreage is 30 to 40 per cent of the total cropped area.



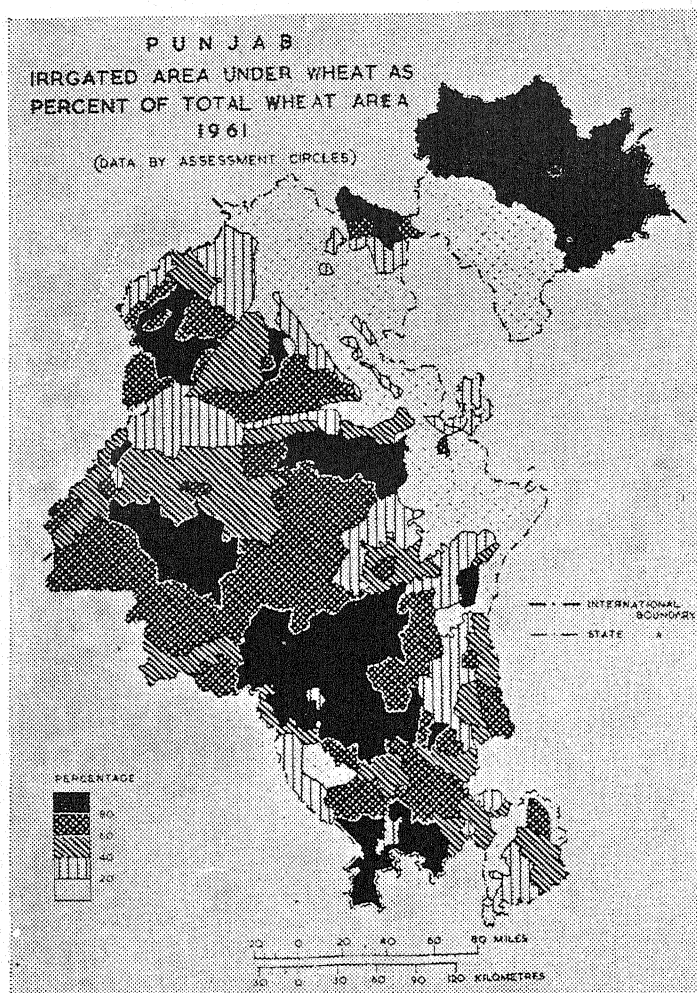
MAP 14

In the Suttlej *bets* it exceeds even 40 per cent. In Patiala tahsil as also in the Yamuna *bets* the proportion ranges between 30 and 40 per cent. In the remaining eastern half of the northern Punjab Plain it is 20 to 30 per cent. Except in the Ferozepur district and the Ghaggar floodplain in the Hissar district, wheat acreage is less than 20 per cent in the southern half of the Punjab Plain, declining to less than 10 per cent in the southern and south-western peripheral zone.

Conditions for wheat cultivation are the most favourable in the northern half of the Punjab Plain where the role of fairly dependable winter rains is supplemented by the moisture stored in the ground from the Summer monsoon rains particularly from those occurring in September. In the western half of this zone where the existing irrigational facilities protect the crop from the vagaries of the retreating monsoons and any irregularities in the cyclonic rains during the winter, wheat crop is supreme, both for food and cash. In large parts of the Bist and Upper Bari *doabs* 60 to over 80 per cent of the wheat area is irrigated (Map 15). In the eastern half of the northern Punjab Plain, on the other hand, the crop is mostly rainfed, as the irrigated wheat acreage is less than 20 per cent.

Wheat cultivation in the *khadar* areas along the rivers, where it covers 30 to more than 40 per cent of the total cropped area, needs special mention. With rise in the level of river water during the rainy season these low-lying areas are flooded and they often do not have any *kharif* crop. There the water-table approaches the surface during the rainy months. But after the retreat of the monsoons in September water-table starts lowering so that by the end of October the land lends itself to wheat cultivation. The *khadar* soils retain moisture even during the winter season and thus often do not need irrigation. Similarly in the lower sections of the Kangra district where over 40 per cent of the total cropped area is under wheat, irrigation is not much needed because of the sufficiency of rains both during summer and winter. In Lahaul and Spiti, on the other hand, wheat is a spring crop and its cultivation is dependent on *kuhl* irrigation.

In the southern and south-western half of the Punjab Plain where the summer rains are lower and variable, and winter



MAP 15

shows lighter than in its northern counterpart, wheat cultivation is dependent on irrigation.

The degree of concentration of wheat is correlated also with fertile silts, silt loams, or clay loams especially those containing certain amounts of lime and humus. Distinctly sandy soils are usually of insufficient fertility for wheat.

Changes in Wheat Acreage During 1951-61

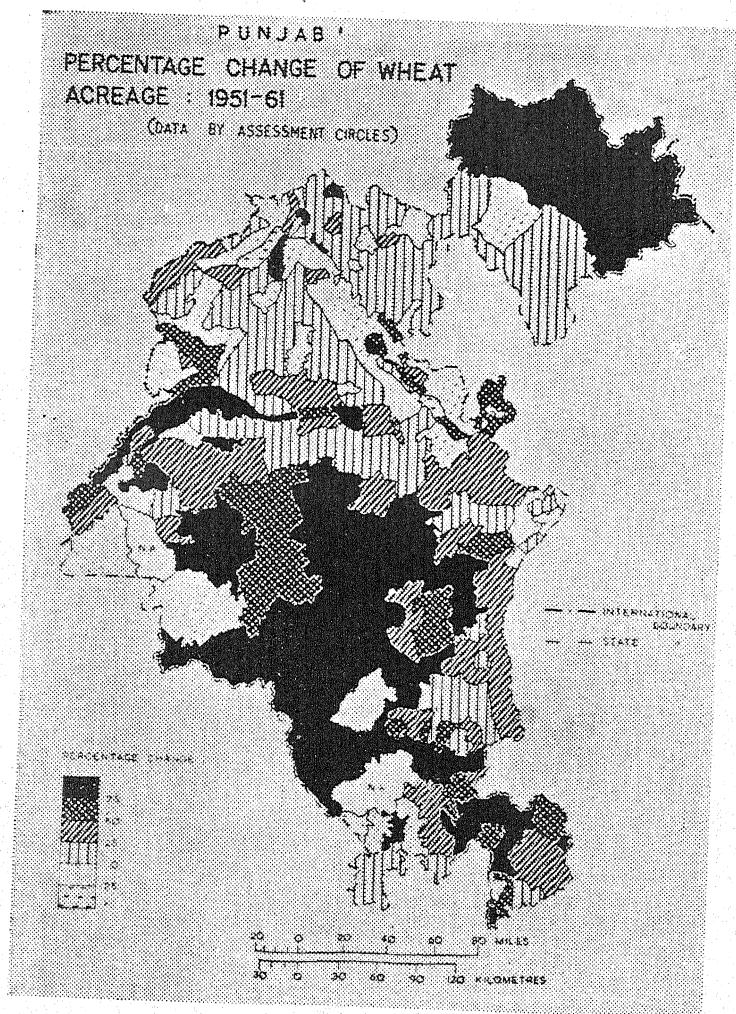
During the years 1951-61 wheat acreage in Punjab increased by 40·8 per cent. As a comparison of Maps 14 and 16 would show, in all such areas where wheat already covers a significant proportion of the total cropped area—such as the Bist and Upper Bari *doabs*, and the lower Sutlej tract—the increase has generally been up to 25 per cent only. In parts of the Hoshiarpur, Gurdaspur and Amritsar districts, there has, in fact, been actual decrease due partly to the extension of water-logging conditions in these areas. In the Sirsa and Fazilka tahsils, on the other hand, a slight decrease in wheat acreage is attributed to the serious competition offered by the more remunerative cash crops.

The largest increase (exceeding 75 per cent) in wheat acreage has taken place in the north-east-to-south-west extending central belt of the Yamuna-Sutlej divide where extensive wastelands have recently been reclaimed and in several of which irrigational facilities have been multiplied with the completion of the Bhakra-Nangal project (compare maps 3, 8 and 16). In some parts it has replaced gram and barley. In all these areas wheat is both a cash and food crop. In the *bets* of the Sutlej river also there has been considerable increase in wheat acreage during the decade. In the Lahaul & Spiti area the percentage increase has been high but the absolute increase is only small.

Bajra

Bajra is the most important *kharif* cereal crop in Punjab. With a coverage of 9·2 per cent of the total cropped area, it is second only to wheat among all the cereal crops grown in the state. Although nutritively as important as wheat, it is considered as an inferior food crop by the Punjabis. Its distributional pattern (Map 17) is complimentary to that of maize. It is a dominant crop of the southern and south-western areas of Punjab where annual rainfall ranges between 15 and 25 inches (Map 18). Here it is sown with the beginning of the summer rain early in July.

The young plants demand a fair amount of moisture but after they are established they tend to be drought-resistant. Bajra is a



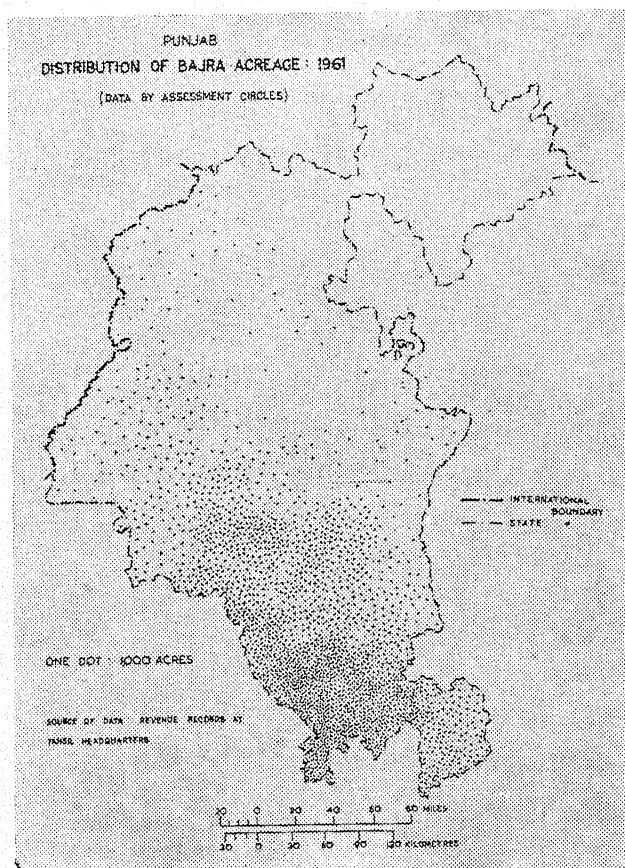
MAP 16

crop of poor light (sandy) soils, and thus occupies over 30 per cent of the total cropped area in the Mahendragarh district and in adjoining parts of the Gurgaon and Hissar districts (Map 19).

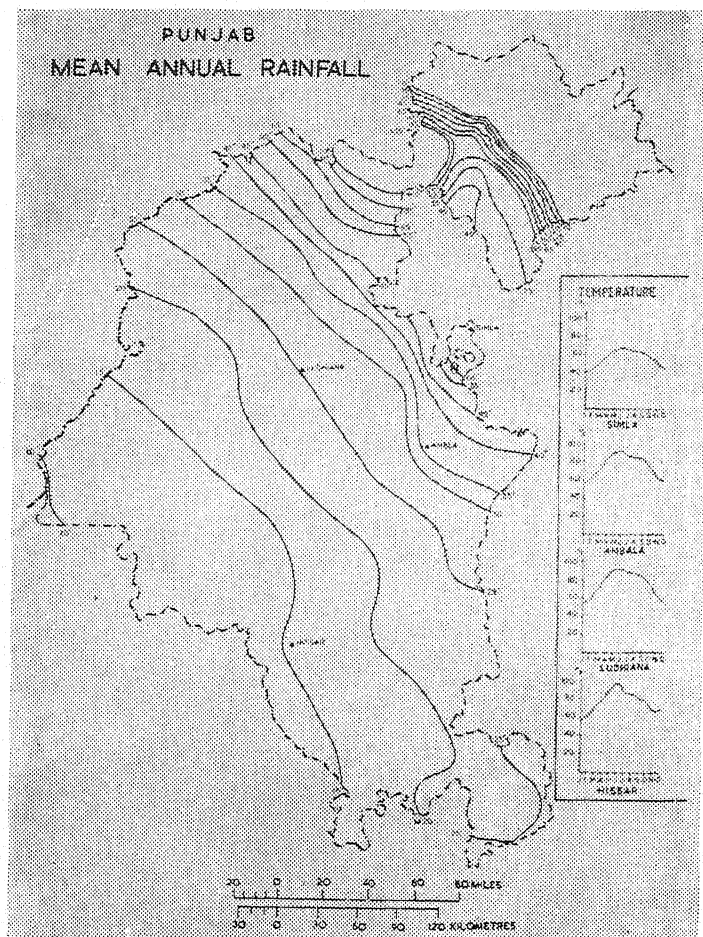
To the north and west of this belt bajra becomes less and less important in inverse relation to increasing water-supply from rains, irrigation or both. In the northern parts of the Punjab

Plain where rainfall is heavier and soils more productive, more remunerative and acceptable crops are grown instead. Here less than one per cent of the total cropped area is devoted to bajra which is grown primarily as a fodder-grain crop for the livestock in marked contrast to its being a staple food in the southern Punjab.

Yields are relatively low compared with other cereals; wherever irrigation is possible, production is generally much higher. In Punjab about 10 per cent of the bajra area is irrigated mostly in the Hissar, Bhatinda, Ferozepur and Sangrur districts.



MAP 17

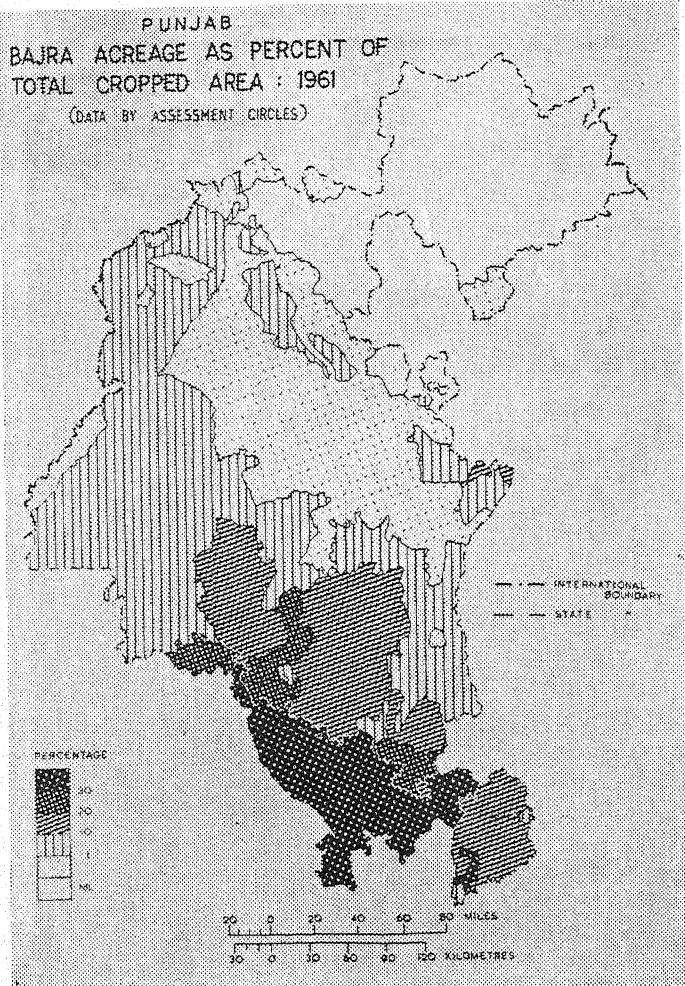


MAP 18

Changes in Bajra Acreage: 1951-61

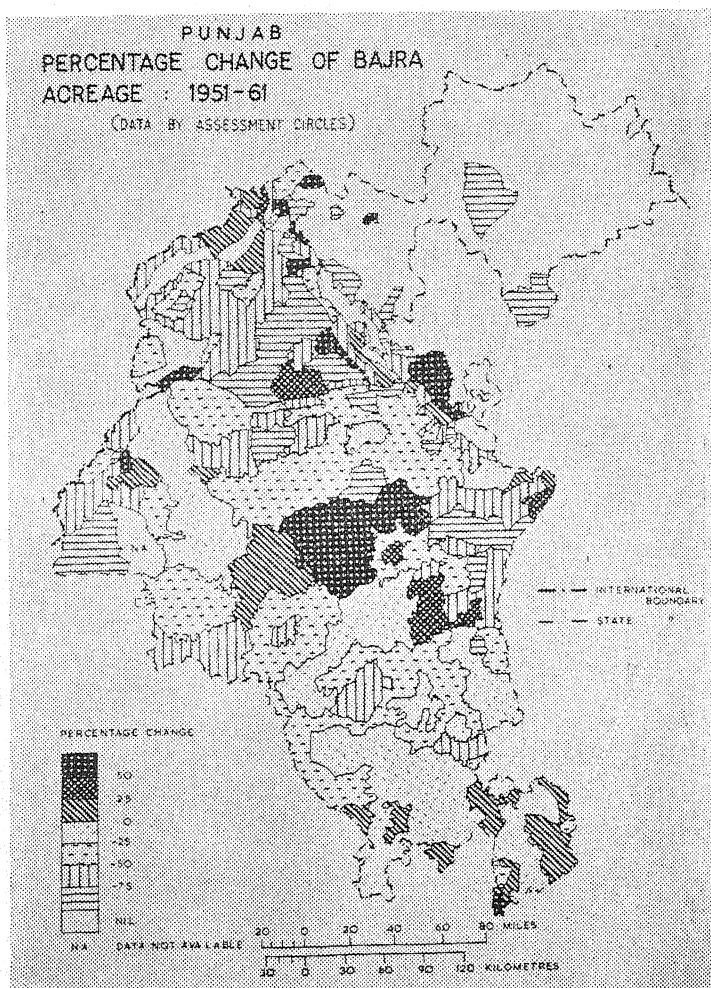
Contrary to the trend in wheat, rice and maize acreage, the area under bajra has gradually decreased from about 2,850,000 acres in 1950-51 to about 2,178,000 in 1961-62.

Interestingly, maximum decrease has taken place in areas where it has been the most important crop (Map 20). With



MAP 19

the introduction of canal irrigation in the central and south-western parts of Punjab, bajra has been replaced largely by crops which pay more, or which are thought of more highly as food crops. Although in some areas, percentage of increase in bajra acreage is considerable but the actual increase is very small. It is amazing how bajra cultivation has persisted so long after



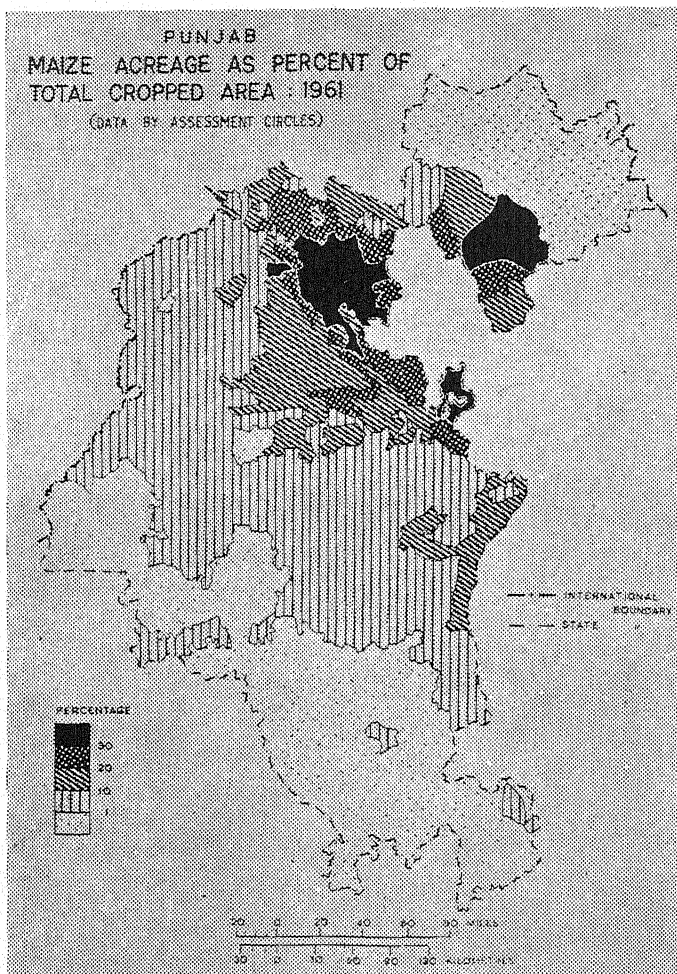
MAP 20

the introduction of canal irrigation in parts of the Ferozepur and Bhatinda districts. It is only in recent years that it has started yielding place to more remunerative crops in these areas.

Maize

With about 5.5 per cent of the total cropped area, maize is one of the most important cereal crops of the *kharif* season. In

their locational pattern the areas of concentration of maize acreage do not overlap with those of any other *kharif* food crop. Throughout the hilly and sub-hilly areas of the Ambala, Simla, Hoshiarpur and Kangra districts where annual rainfall exceeds 40 inches and the sloping surface provides excellent drainage, maize covers 20 to over 30 per cent of the total cropped area



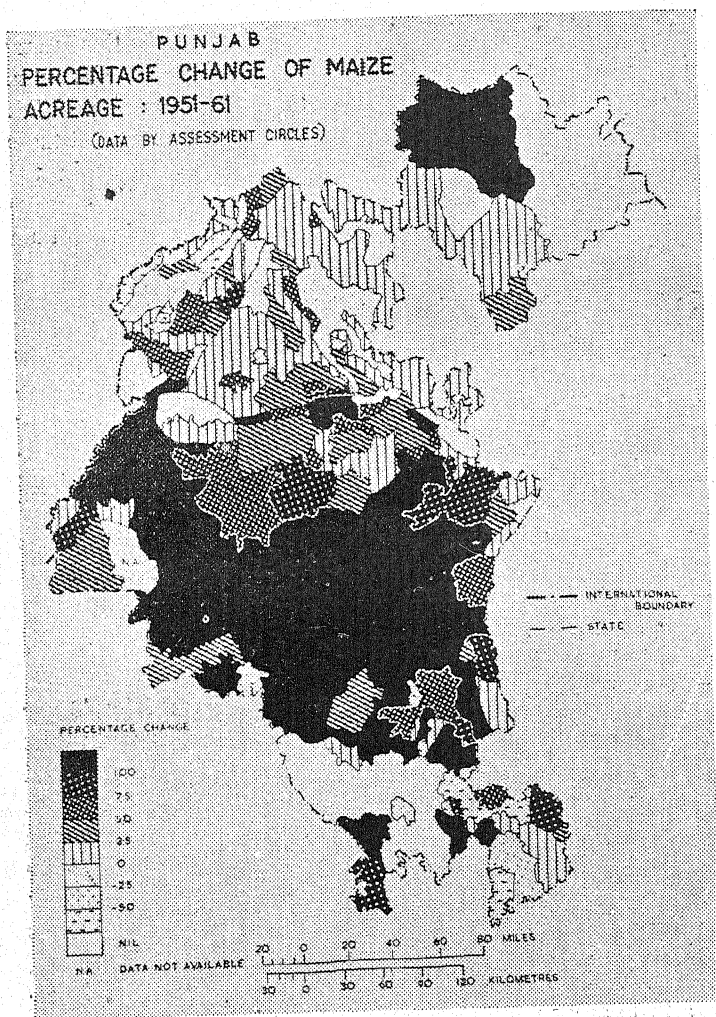
MAP 21

(Map 21). Here maize is mainly a rainfed crop. In fine loamy soils of the Bist *doab* and the northern *khadar* of the Yamuna 10 to 20 per cent of the cropped area is devoted to maize. With decrease in rainfall from the Siwaliks toward the south-west there is corresponding decrease in maize acreage, so that in the southern and south-western zone where rainfall is less than 20 inches and soils predominantly sandy, maize acreage is less than one per cent of the total cropped area.

In between the foot-hill and south-western zones the corresponding figure ranges between 1 and 10 per cent. Since the season of maize crop from sowing till harvest synchronises with the rainy season, the distributional pattern, adequacy and regularity of summer rainfall are crucial factors in maize cultivation. Wherever rainfall is inadequate, it must be supplemented with irrigation as is done in the Bist *doab*. Thus about 42 per cent of the total maize area in Punjab receives irrigation. In areas where the annual rainfall is below 25 inches, maize cultivation is almost exclusively dependent on irrigation.

Changes in Maize Acreage : 1951-61

In the state as a whole, maize acreage increased by 43 per cent during 1951-61. However, in the north-east-to-south-west extending central belt of the Yamuna-Sutlej divide, where canal irrigation has recently been extended and considerable amount of wasteland has been reclaimed, maize acreage has more than doubled during the ten years. This increase is generally confined to areas of fine loams, rather than to predominantly clayey or sandy soils. In some of the *khadar* areas of the Sutlej and Beas rivers also, where land has been reclaimed and protected from floods, maize cultivation has extended (Map 22). By contrast, in almost all the areas where it was already an important crop, such as the hilly and sub-hilly zones and the Bist *doab*, maize acreage increased or decreased by a small margin. However, in several areas in the Amritsar and Gurdaspur and the *bets* of the Sutlej and Beas rivers where water-logging conditions have developed, maize has been replaced by rice to a considerable extent.



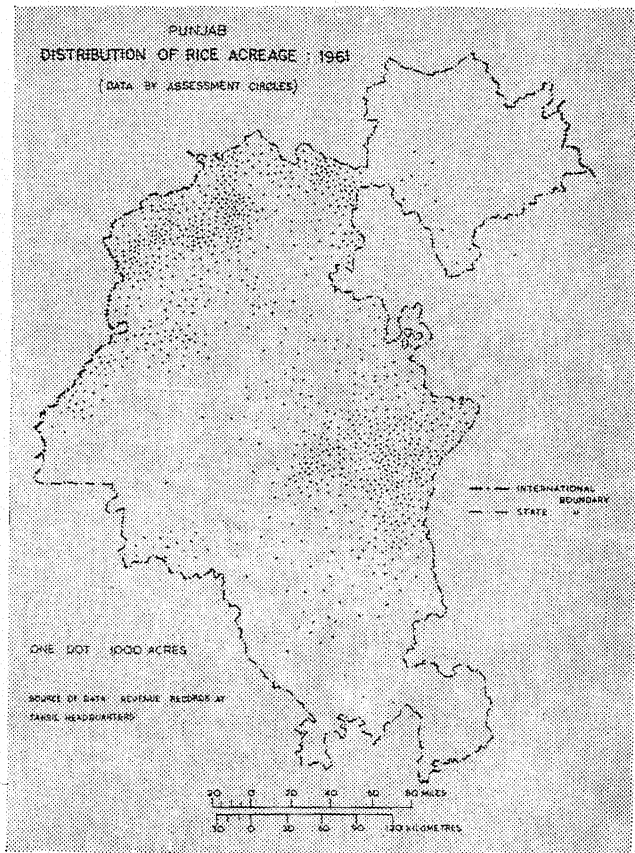
MAP 22

more higher yield. However, conservative as the peasants are, the progress is rather slow and spotty. With an effectively organised agricultural extension service, educating the farmers about the precise water and fertilizer requirements of the new crop and the techniques of its cultivation, hybrid maize can replace the indigenous low-yielding crop without any difficulty.

But by persuasion and demonstration faith must be infused into the farmer about the usefulness of new innovations.

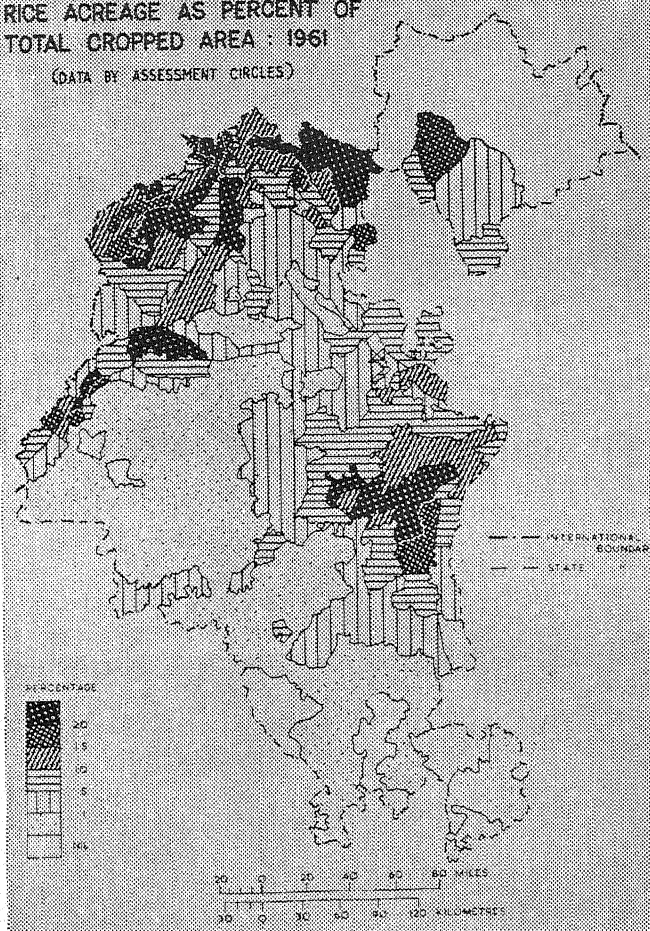
Rice

Accounting for only 4.4 per cent of the state's total cropped area, as against 24 per cent in India as a whole, rice cultivation is really restricted in Punjab where it is grown as a *kharif* crop. The requirements of rice with regard to climate, land-forms and soils are rather precise. In the plains and the lower hills, water-supply, and not temperature, is one of the critical



MAP 23

PUNJAB
RICE ACREAGE AS PERCENT OF
TOTAL CROPPED AREA : 1961
(DATA BY ASSESSMENT CIRCLES)



MAP 24

factors. Little rice is grown where the water-supply (from rains or irrigation or both) is less than 40 inches. The amount of water needed increases from planting time to the middle of the vegetative period and decreases thereafter. Since the supply has to come at regular, closely spaced intervals, irrigation, even in areas having otherwise adequate rainfall, becomes necessary.

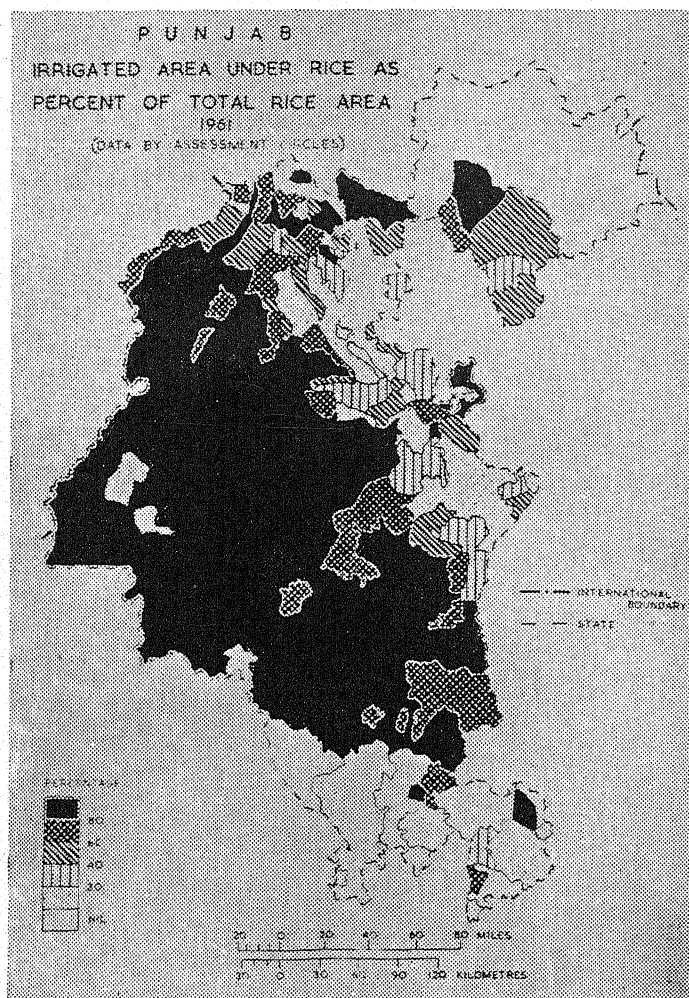
The rain or canal water, which is muddy, is considered more useful than that supplied from wells/tube-wells. Two types of soils are best for rice: (i) clays or clay loams with more or less impermeable clay or clay loam sub-soils; (ii) loams with more or less impermeable sub-soils. Sandy, porous soils are not suitable for rice. The factors discussed above set the outer limits of rice cultivation in the state. But within the zone of potentiality, cultural and economic factors cause a lot of differentiation.

There are two areas of concentration of rice cultivation : (i) the north-western zone comprising the sub-hilly areas of the Kangra district, the Gurdaspur and Amritsar districts, and the floodplains of the Beas and lower Sutlej rivers; and (ii) the north-eastern zone centred on the Naili and Nardak assessment circles and the *khadar* of the Markanda in the Karnal district (Map 23). In both these zones rice covers 10 to more than 20 per cent of the total cropped area (Map 24).

In the hilly areas of the Kangra and Simla districts the sloping surface is converted into terraced fields which are far more intensively cultivated than the plain areas. Rainfall is heavier and more reliable, yet supplemental irrigation from *kuhls* and springs becomes necessary. In the Gurdaspur and Amritsar districts, on the other hand, rainfall is inadequate, variable and irregular. Thus here rice cultivation is dependent on irrigation, particularly from canals (compare maps 24 and 25). Rice cultivation in the floodplains of the Beas and lower Sutlej rivers requires fewer waterings than elsewhere. The *bets*, wherever their soils have a high content of clay, are potential areas for rice cultivation.

In the north-eastern zone, especially in the Karnal district which is now considered as the rice bowl of Punjab, rice cultivation is different from that in the north-western zone in many respects. Firstly, it is of recent development, following largely upon the reclamation of the wastelands in the Naili and *khadar* assessment circles of the Kaithal and Thanesar tahsils and Nardak circles of the Karnal tahsil. Here almost a quarter of the cropped area is devoted to rice (Map 24). Secondly, it is a major cash crop. The extension of canal and tube-well irrigation in

recent years provided great stimulus for rice cultivation in this area of clay loams. Thirdly, this new development has not been the work of local people who were unaccustomed to growing rice but of the enthusiastic in migrants from the Amritsar and Gurdaspur districts and the displaced persons from the Sialkot and Sheikhupura districts who were familiar with the



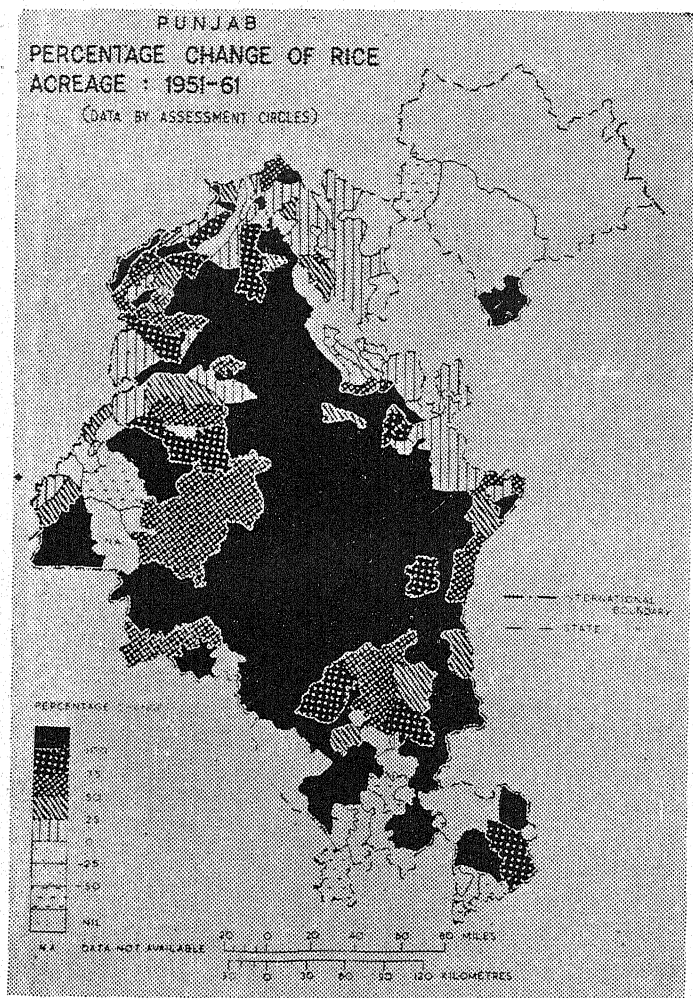
know-how of rice cultivation. Their efficient methods of rice cultivation are now gradually percolating to the local peasantry.

As is evident from Map 25, it is only the narrow foot-hill zone of the Ambala, Hoshiarpur and Gurdaspur districts with an annual rainfall of 35 to 40 inches where rice cultivation is done without much irrigation. Here, generally less than 20 per cent of the rice area is irrigated; but in some localities the proportion exceeds even 60 per cent. The different varieties of rice have varying water requirement. In order to achieve high yields per acre, however, supplemental irrigation will be necessary everywhere. In practically all areas south of this zone, rice is wholly dependent on irrigation, the proportion of irrigated rice acreage exceeding 80 per cent (Map 25).

Changes in Rice Acreage : 1951-61

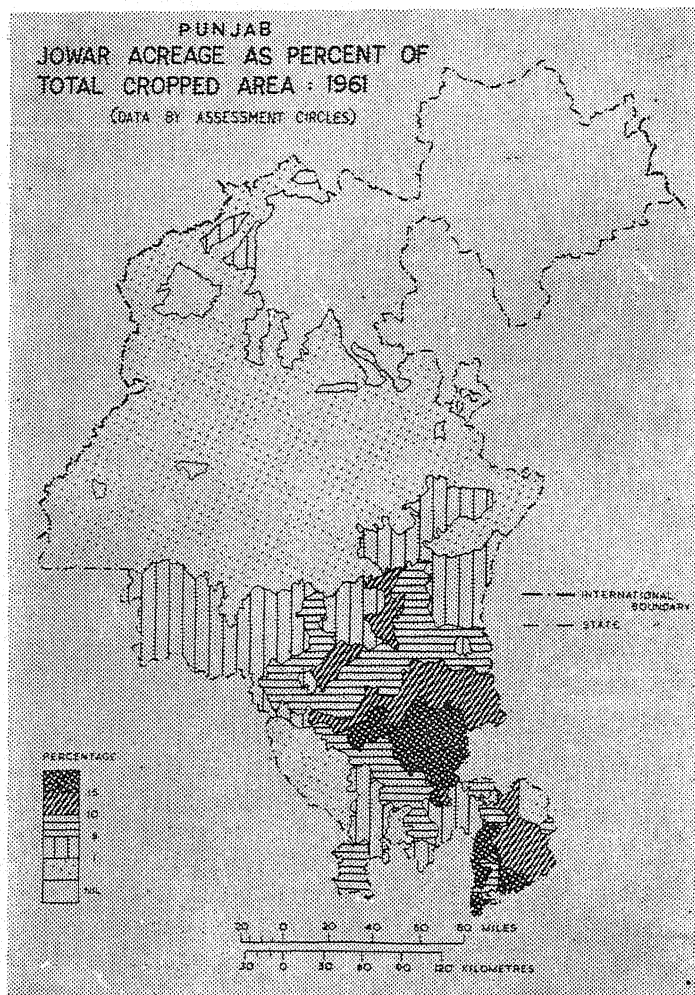
Only a few crops in Punjab witnessed as spectacular an increase in area as did rice during 1951-61. The area under rice rose from 572,000 acres in 1951-52 to 1,103,000 acres in 1961-62. However, this increase was far from being uniform (Map 26). Throughout the narrow foot-hill zone of the Ambala, Hoshiarpur and Gurdaspur districts where facilities for supplemental irrigation are inadequate the increase was marginal. In parts of the Hoshiarpur district, in fact, there was decrease in rice acreage. In the mountainous district of Kangra also the area under rice suffered considerable decrease. In parts of the canal irrigated Ferozepur district more remunerative crops like cotton and oilseeds are encroaching upon less important crops including rice.

The greatest increase in rice acreage has taken place where: (i) new irrigation has been introduced; (ii) wastelands have been reclaimed; and (iii) near-water-logging conditions have emerged. The most spectacular increase has taken place in the newly broken wastelands in the Karnal and Patiala districts simultaneously with the extension of irrigation from the Bhakra canal, new wells and tube-wells. In the Karnal district area under rice increased from about 92,000 acres in 1951 to 253,000 acres in 1961, whereas in the Patiala district the increase was from about 23,000 acres to 83,000 acres. Although in several of the



MAP 26

other areas the increase exceeds 100 per cent but actual area involved is small. In the floodplains of the Yamuna, Ghaggar, Sutlej, Beas and Ravi also rice cultivation has recently been expanded. In parts of the Amritsar and Gurdaspur districts and also of the Bist *doab* the development of water-logging has stimulated rice cultivation.



MAP 27

It will be pertinent to note here that with unprecedented increase in rice acreage during the last decade more and more people have taken to rice-eating thereby releasing corresponding pressure on wheat consumption and creating an exportable surplus in wheat. Extension in paddy cultivation is a welcome development on another ground. As acre for acre rice can feed more people than any other cereal crop, expansion in its

cultivation will help in supporting the fast growing population of the state.

Jowar

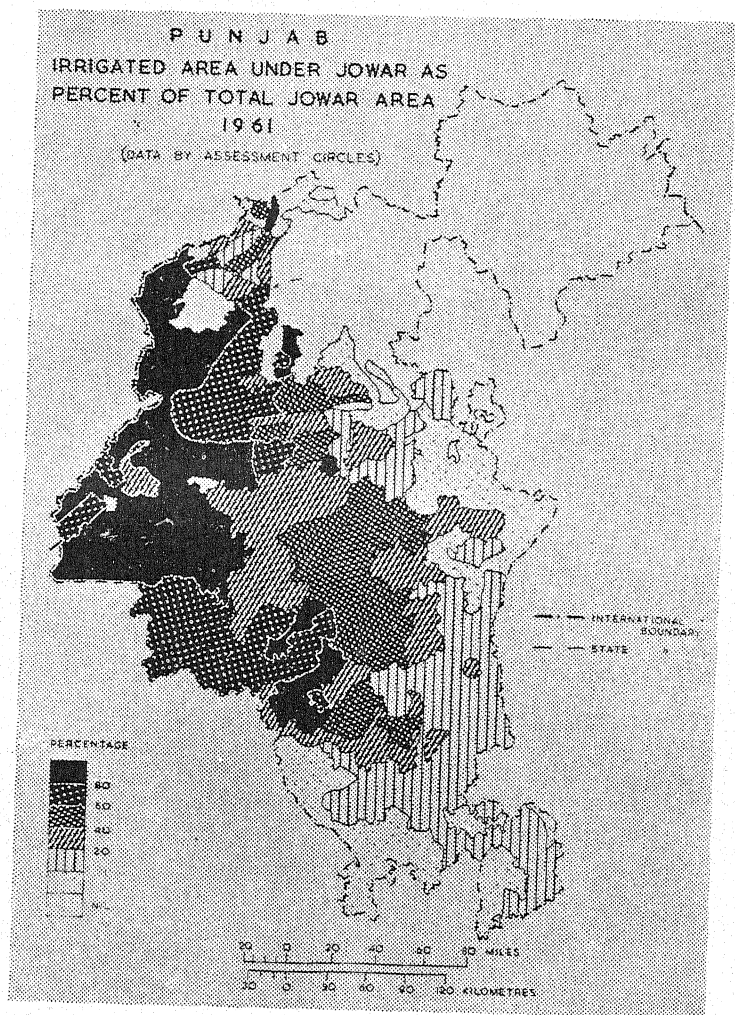
With only 3·1 per cent of the total cropped area, jowar is the least important cereal crop of the *kharif* season in Punjab. Although, like bajra, it is grown as a grain crop only in less rainy areas, it tends to be concentrated where the soils have a higher content of clay than sand, whereas bajra flourishes more in sandy soils. In terms of water supply also, the requirements of jowar are somewhat greater than those of bajra. Both the crops give satisfactory yields on poor soils, require only a short growing season, and need little cultivation. Both are sown by broadcast method and seldom need weeding.

Although jowar is grown as a green fodder crop in all parts of the state, its importance as a grain crop is confined to Rohtak and Gurgaon districts where in parts it covers more than 15 per cent of the total cropped area (Map 27). In the Ferozepur Jhirka and Nuh tahsils of the Gurgaon district, jowar is generally grown in low basins between the Aravalli ridges where some water accumulates during the rainy season and where the soils tend to be clayey. Both to the north and west of the Rohtak-Gurgaon area the proportion of jowar acreage decreases rapidly so that throughout the northern half of the Punjab Plain it is less than one per cent. In the Sirsa, Fatehabad and Hissar tahsils of the Hissar district where only one to over 5 per cent of the total cropped area is devoted to jowar, the crop is grown with the help of irrigation. Similarly in the Ferozepur and Amritsar districts, where the jowar acreage is less than one per cent of the total cropped area, it is almost exclusively dependent on irrigation (Map 28).

With the extension of irrigation from canals, tube-wells or wells, jowar as a cereal crop is gradually being replaced by superior food or cash crops.

Barley

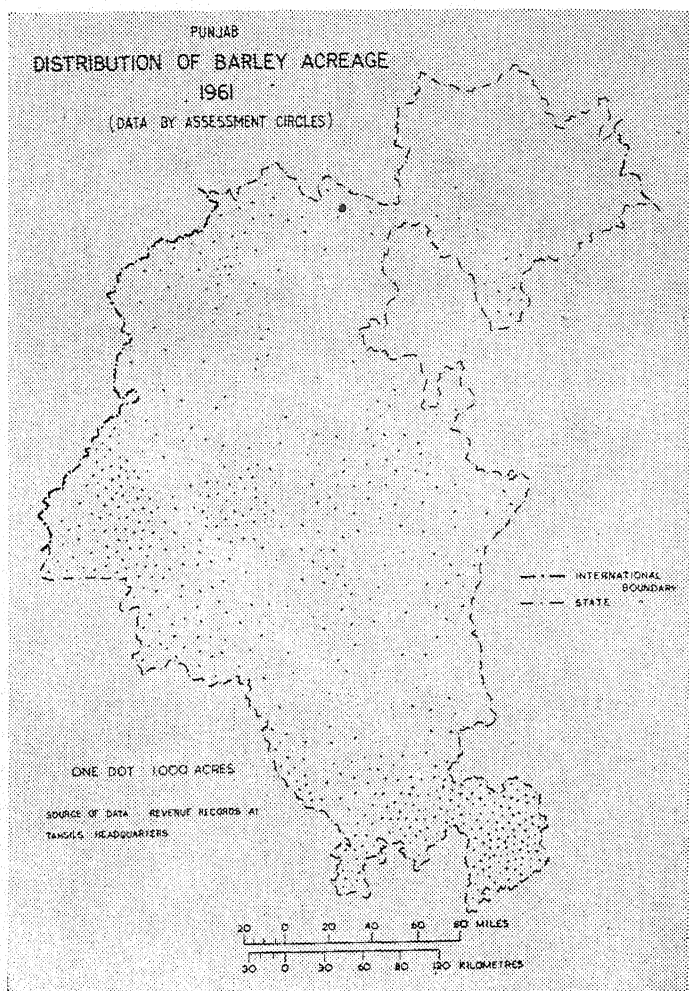
Only about two per cent of the total cropped area is devoted to barley. In most parts of Punjab it is grown primarily as a fodder crop as it requires less water than does wheat. Most of



MAP 28

the barley area is confined to the Yamuna-Sutlej divide (Map 29). The greatest concentration is in the Gurgaon district where it is one of the staple food crops. Here it covers about 8 per cent of the total cropped area.

It is also grown, though only sparsely, in the Ferozepur, Hissar, Sangrur, Patiala and Mahendragarh districts. Its acreage



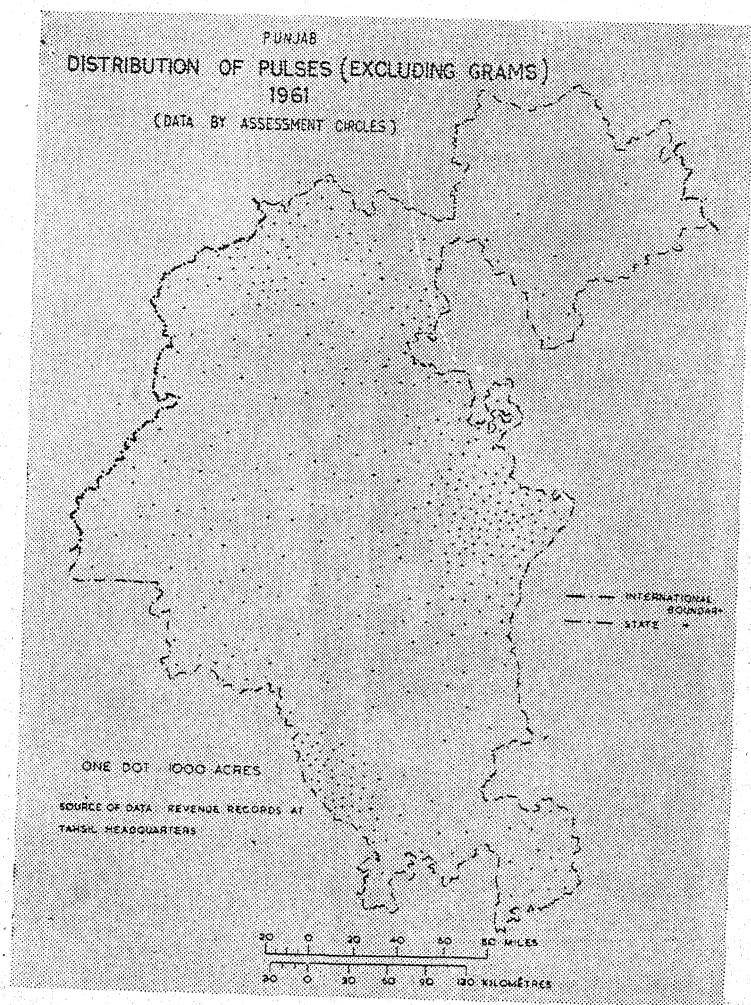
MAP 29

is gradually declining, as with extension of irrigation it is being replaced by wheat.

Pulses

With less than 2 per cent of the total cropped area, pulses—such as *mash*, *moong*, *massar* and *moth*—are minor crops mostly

grown with other crops by inter-culture methods in both the seasons. Pulses are the main source of proteins in the food of the poor people, and are the substitute for vegetables rather than a supplement. Although some pulse or the other is grown in every area, yet most of their acreage is concentrated in the northern half of the Punjab Plain (Map 30).



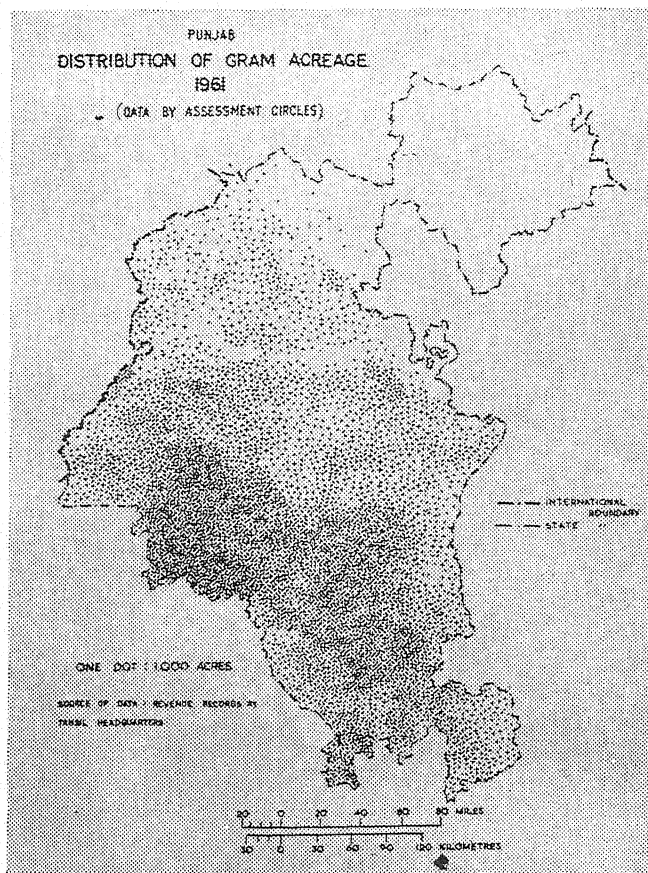
MAP 30

The area under pulses has declined by about 25 per cent during the last decade. Evidently, the general trend of agricultural land-use emerging in various parts of the state is marked by replacement of minor food and other less remunerative crops by major food and cash crops.

Gram

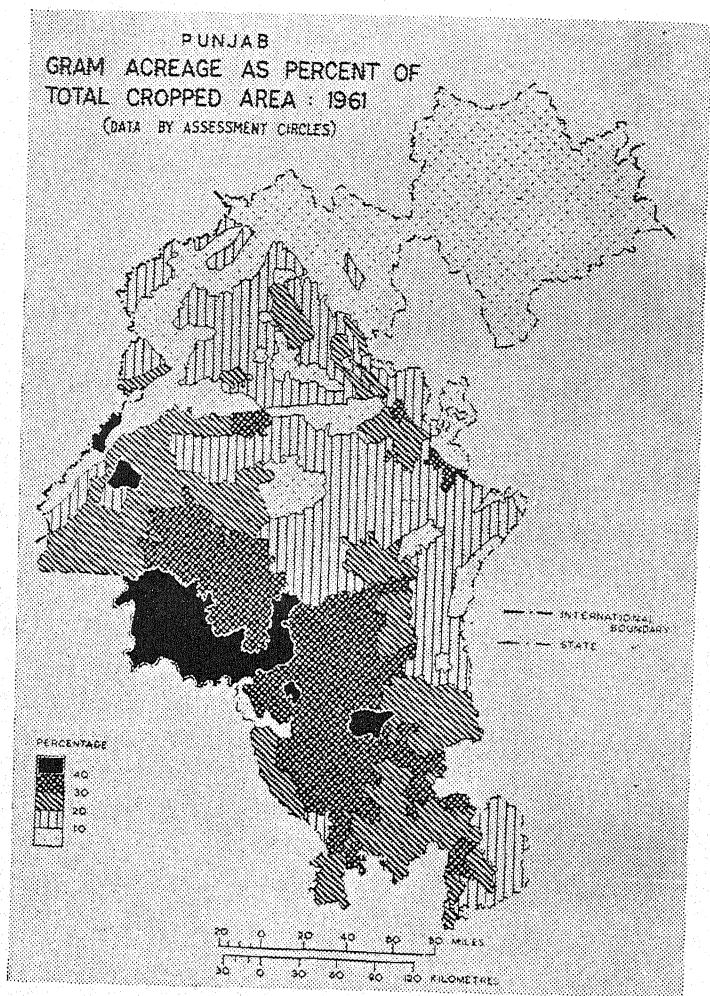
With a coverage of about 25 per cent of the total cropped area which is the highest in any state in the country, gram is Punjab's leading crop with wheat coming as a close second. It is grown for multiple uses—as a pulse, as a food and as a feed grain for the livestock. Gram requires less water than wheat, and does well in sandy loams. Thus wherever the conditions are less favourable for wheat in terms of water and soil requirements, gram is the supreme *rabi* crop (Map 31). Moreover, whereas wheat crop is preceded by fallowing during the *kharif* season, particularly in areas having inadequate irrigational facilities, gram follows maize, jowar or bajra in the rotation of crops. It seldom requires fallowing to precede it because it can grow in light soils and with only light winter showers.

Following the *kharif* crops, gram is grown pure or in combination with wheat, barley or oilseeds depending on moisture conditions and soil types. Thus the distributional patterns of wheat and gram are complementary (Maps 14 and 32). In the south-east-to-north-west extending belt of southern Punjab there is unusual concentration of gram (Map 31). Here 30 to 40 per cent of the total cropped area is devoted to this crop. In parts of the Sirsa and Fatehabad tahsils, the proportion exceeds even 40 per cent (Map 32). Throughout this belt annual rainfall is less than 20 inches, winter showers are lighter than in the north, and variability of precipitation is high. Soils are generally sandy loams. Thus all conditions favour gram cultivation. However, wherever conditions are too dry, some amount of irrigation becomes necessary. As a result, 20 to over 40 per cent of the gram area receives irrigation in this belt. But with increasing facilities of irrigation gram is gradually being replaced by wheat or at least is being grown increasingly in combination with wheat as has been seen in the Hissar, Bhatinda and Ferozepur districts.



MAP 31

In marked contrast to the southern belt, gram occupies only 10 to 20 per cent of the total cropped area in the northern half of the Punjab Plain where wheat is the dominant crop. In the floodplains of the Yamuna, Sutlej and Beas rivers, and in other areas where soils are too wet even during the winter, gram cultivation is rather unimportant. In the mountainous districts also it is an insignificant crop. Throughout the northern plain gram follows maize or *chari* (jowar grown primarily for fodder) and it is grown either pure or in combination with wheat, barley, oilseeds depending on moisture conditions and soil types.



MAP 32

However, in a few local areas immediately in the foot of the Siwalik Hills, where water-table is deep, soils highly porous and irrigation facilities lacking, gram is relatively important.

Punjab is a surplus producer of gram and thus exports large quantities of this grain to other states of India.

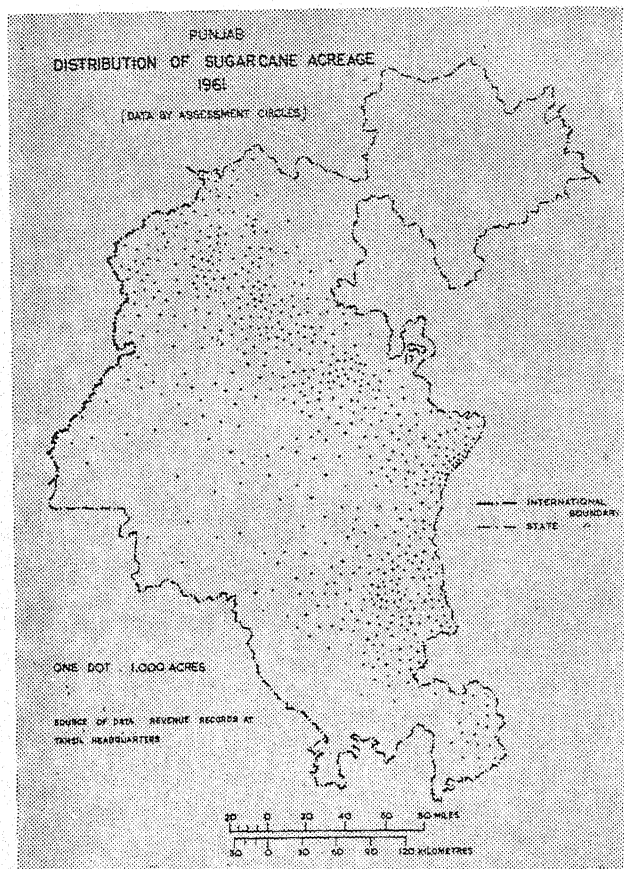
Sugarcane

In the northern India sugarcane has been grown from very early times, and has served for the small-scale manufacture of what is called "gur", unrefined brown sugar of varying quality and composition. While the bulk of the sugar still consists of gur (or "shakkar", a slightly refined powdery sugar), in recent decades the consumption and domestic production of refined sugar have increased greatly. Till recently the typical sugarcane grown throughout this region was of hardy varieties with low sugar content. However, in recent decades, through cross-breeding with richer, tropical canes, a number of new varieties have been evolved which give considerably higher yields.

In Punjab sugarcane is sown in early March. Growth ceases in late November or early December. Harvesting generally takes place from December to February, thus allowing only one crop in a field during the course of a year. Ratooning of the crop is a common practice.

With 2.7 per cent of the total cropped area sugarcane is one of the most important cash crops in Punjab. Its distribution is, however, marked by regional inequalities (Map 33). Throughout the south-western zone, where semi-arid conditions prevail, sugarcane cultivation is practically absent. The small acreage, less than one per cent of the total cropped area, which is devoted to this crop here is restricted to the canal irrigated areas. However, since the canals do not contain sufficient water to provide irrigation over a large part of the year, the prospects of extending sugarcane cultivation in this zone are not bright at all. Moreover, here sugarcane has to compete with highly remunerative crops like cotton and oilseeds.

In correspondence with increase in rainfall toward the north-east, sugarcane acreage increases in that direction so that in the north and north-east of the semi-dry zone discussed above, the proportion exceeds one per cent everywhere. However, in areas along the main rail routes the proportion generally ranges between 5 and 10 per cent. Within these areas it exceeds even 10 per cent in a number of localities (Map 34). In the Jagadhari, Thanesar and Panipat *khadars*, as also in the Nehri circles of the

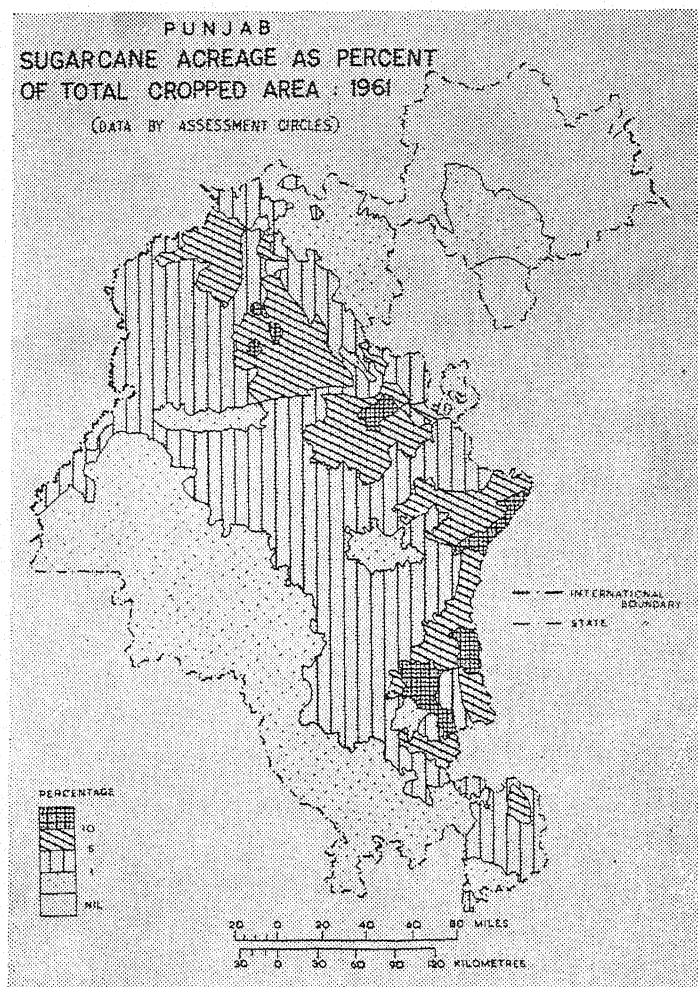


MAP 33

Gohana and Rohtak tahsils where canal irrigation more than compensates the deficiency of rainfall, more than 10 per cent of the total cropped area is devoted to sugarcane.

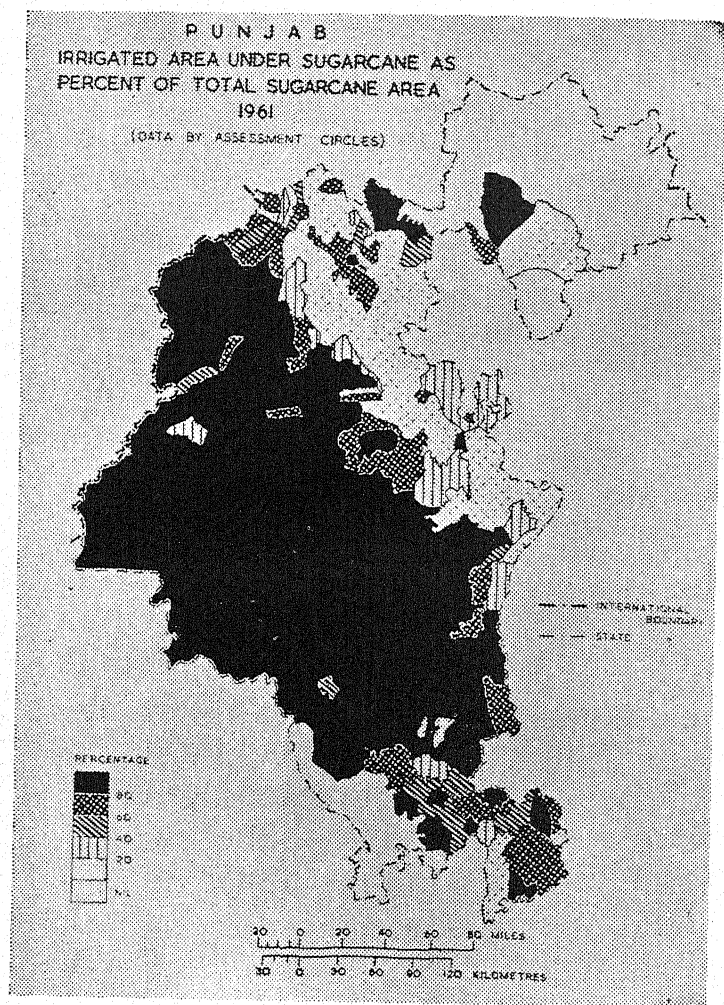
It may be noted that the pockets of highest sugarcane acreage are generally around places having sugar mills. Wherever new mills have been set up in recent years the cane acreage has shown spiralling rise.

Except in the foot-hill zone of the Ambala, Hoshiarpur and Gurdaspur districts where the annual rainfall exceeds 30 inches,



MAP 34

sugarcane cultivation requires irrigational facilities particularly during the pre-monsoon period. Thus, whereas in the northern zone generally less than 20 per cent of the sugarcane area is irrigated, elsewhere the proportion exceeds 80 per cent (Map 35).

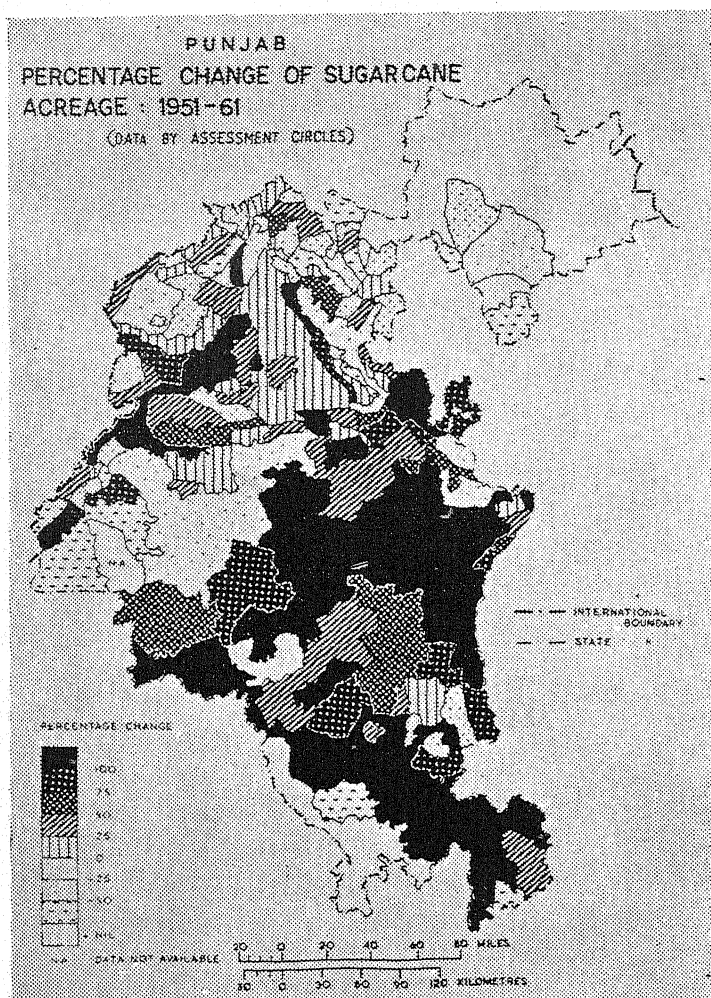


MAP 35

Changes in Sugarcane Acreage during 1951-61

Although sugarcane cultivation is very old in the northern Punjab Plain yet its emergence as an important cash crop dates back to the Second World War during which imports of sugar were suddenly cut off and there was phenomenal rise in its price

which has been stable ever since. Thus there has been rapid increase in its acreage, relegating cotton to a secondary place among cash crops. Also, with the rapidly growing population in the country in recent decades, the demand for sugar has been increasing. Consequently a deliberate increase in sugarcane acreage and production has been an integral part of agricultural



planning in the post-Independence era. A small surplus in production thus achieved would earn the much needed foreign exchange for the country. During 1951-61, the sugarcane area in Punjab increased by more than 50 per cent. The greatest increase took place in the eastern and central parts of the Yamuna-Sutlej divide where ample irrigational facilities (from canals, tube-wells and wells) have been introduced during the decade (Map 36). The increase is also considerable in the floodplains of the major rivers where the soils are sufficiently wet to grow sugarcane even without much irrigation. In the water-logged areas also sugarcane is becoming a popular crop. However, in parts of the Ferozepur, Bhatinda, Sangrur, Ludhiana and Amritsar districts where there is severe competition from other crops, its acreage has declined during the decade.

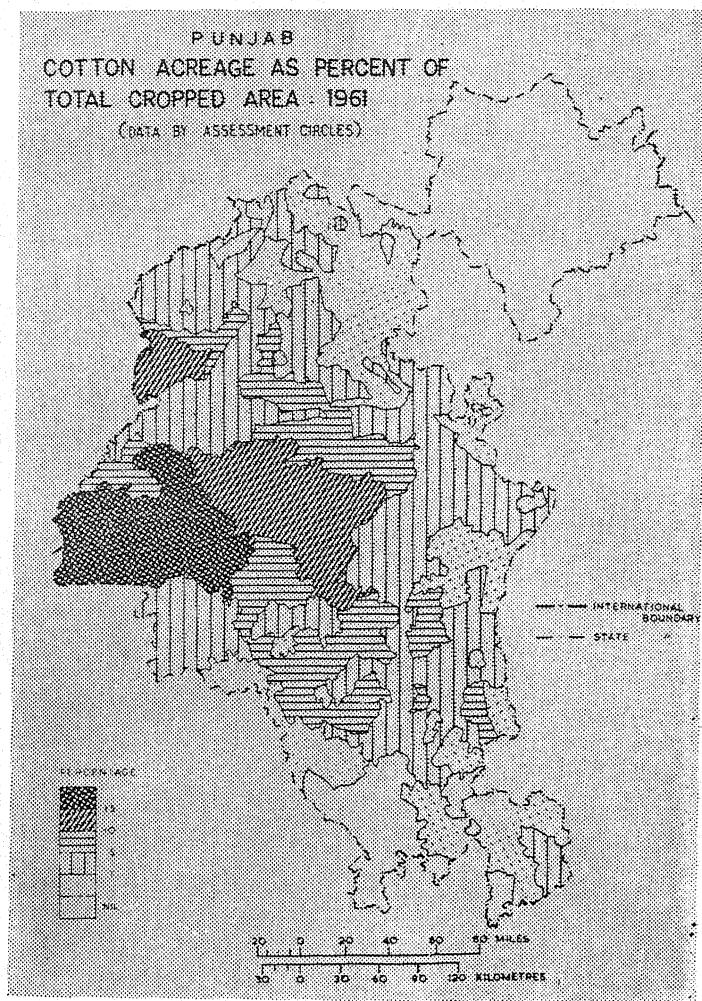
The yields of sugarcane in Punjab are still low. The increased use of better seeds and fertilisers, protection against pests and plant diseases, and further development of irrigation through minor projects can surely yield heavy dividends. Since the crop occupies the field for practically the entire year and often needs fallowing during the preceding crop season, it leads to, on the average, less than one crop a year. To overcome this disadvantage, other crops should be grown along with sugarcane by inter-culture methods. The experiment of growing peas in the sugarcane fields in the Ganga-Yamuna *doab* has been very successful and should be introduced in Punjab also.

Cotton

Punjab has produced cotton for centuries and the crop is firmly established in the state's agricultural system. It is fourth in acreage, following gram, wheat and bajra. With about 6 per cent of the total cropped area, it is the leading cash crop. Although it is grown for domestic purposes practically everywhere in the state, its cultivation for commercial purposes is confined only to certain areas where conditions for the crop are favourable (Map 37). It is a *kharif* crop sown generally after the onset of the summer monsoons.

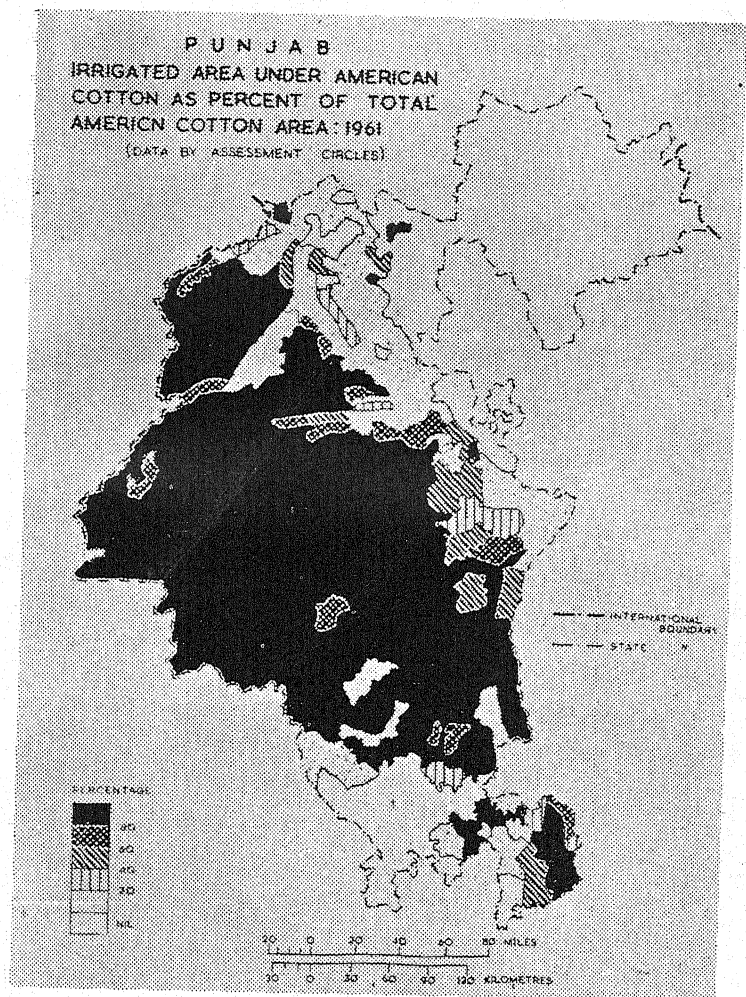
Temperatures being sufficiently high throughout the crop season, water-supply is the main critical factor in the production

of cotton in Punjab. The total water requirements of this crop are far less than those of rice and sugarcane, but what it needs the most is the regular availability of water over the growing season. The most beneficial distribution of rainfall during the growing season is that showers should be frequent, but light, immediately



after sowing. This aids germination of the seed and proper growth of the tap root. Heavy rains at this time induce shallow-rooting, which can have serious results should a period of below-normal precipitation occur later in the growing season. During the period of vegetative growth, moderate rainfall is the most conducive. A drier period should follow to allow the balls to ripen and be picked. Occasional light showers during the picking season are desirable to prevent the premature opening of the balls. In view of great irregularity in the occurrence of rainfall during the rainy season, and fairly high variability from year to year, supplementary irrigation is necessary for successful cotton cultivation almost everywhere in the Punjab Plain (Maps 38 and 39). Equally important is the need of sufficient sunshine during the growth period. That is why cotton flourishes best in hot dry areas provided adequate irrigational facilities are available. Moreover, the hot, dry areas are generally immune to plant diseases and pests which so much infest the humid regions. Although cotton can be grown in a large variety of soils, the most suitable is that which contains equal proportions of sand, silt and clay, together with a considerable amount of organic matter. While it should have favourable drainage and aeration, it should also have good moisture holding capacity. Very rich soils are not desirable as the plant registers excessive vegetative growth at the expense of the fruit.

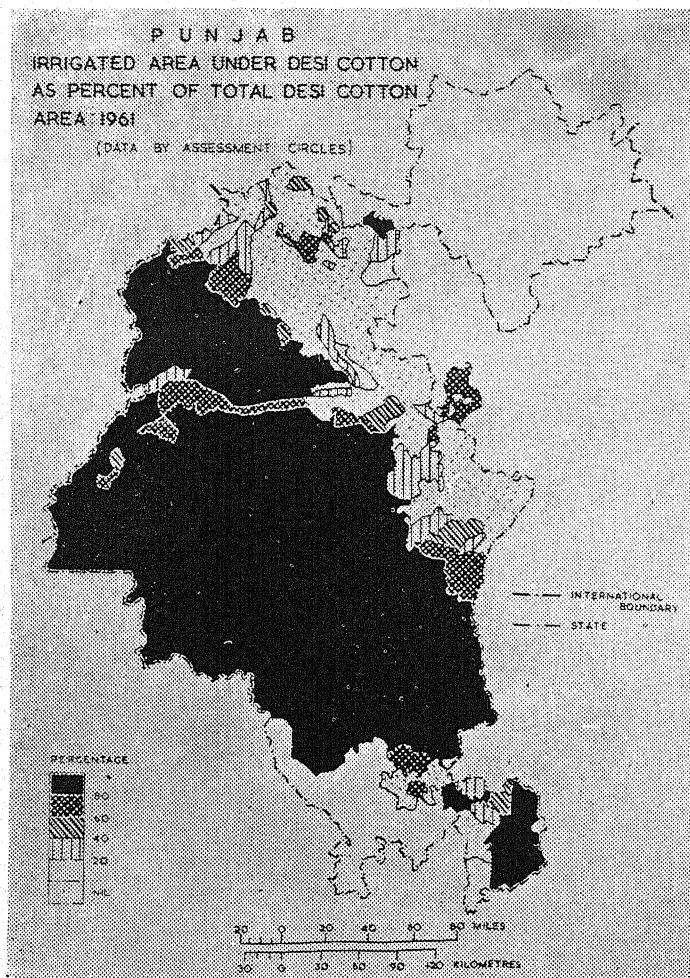
In conformity with the conditions most favourable for cotton cultivation discussed above, the canal irrigated south-western and central districts of the Punjab Plain are the most important cotton growing areas in the state. In large parts of the Ferozepur and Bhatinda districts more than 15 per cent of the total cropped area is devoted to cotton. In a few assessment circles of the Muktsar and Fazilka tahsils in the Ferozepur district, the proportion is as high as 25 to 35 per cent, making cotton as the first ranking crop in these circles. In these areas land holdings are large releasing considerable land for cash crops after keeping sufficient area for growing food crops. In the Patti tahsil of the Amritsar district and the northern parts of the Sangrur district, which also receive adequate canal irrigation, cotton occupies 10 to 15 per cent of the total cropped area. In the adjoining areas of the Hissar district in the south and Ludhiana



MAP 38

and Patiala districts on the north the corresponding proportion ranges between 5 and 10 per cent. The percentage becomes below 5 (even below one in some pockets) to the south, east, north-east and north-west. In the Lahaul & Spiti, Mahendragarh and large parts of the Kangra districts cotton is not grown at all.

Excepting the northern zone of the Punjab Plain where annual rainfall exceeds 30 inches, cotton cultivation is wholly dependent on irrigation almost everywhere in the state (Map 38 and 39). In recent years the long staple American cotton has gradually been replacing the short staple *desi* cotton. In the Ferozepur district where there is a dense network of irrigation



MAP 39

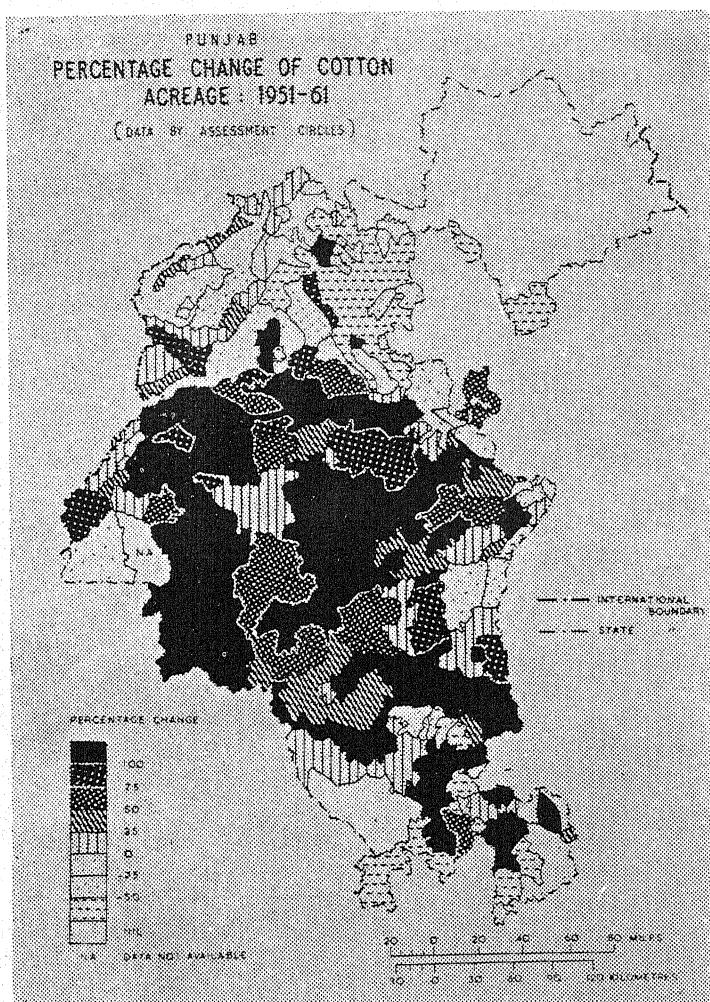
canals a large proportion of the cotton acreage is under long staple cotton. In the Bhatinda and Sangrur districts, on the other hand, the short staple cotton still predominates. Since the long staple gives superior fibre and yields heavily, it should replace *desi* cotton in all areas where conditions for growing cotton are otherwise favourable.

Changes in Cotton Acreage during 1951-61

There are only a few crops the acreage of which increased so spectacularly during the decade as that of cotton. Its area increased from about .75 million acres in 1951 to 1.4 million acres in 1961. The greatest increase took place in those areas of the Yamuna-Sutlej divide where new canal irrigation has been recently introduced (Map 40). In Guru Harsahai, Zira Rohi and Gray Canal circles of the Ferozepur district; and Hissar, Sirsa and Fatehabad tahsils of the Hissar district the cotton acreage increased by more than five times. Similarly in several assessment circles of the Rohtak district the increase was no less dramatic. In the Patiala, Rajpura, Sangrur, Malerkotla, Faridkot and Bhatinda tahsils the increase ranged between 175 and 230 per cent. In the newly reclaimed wastelands of the Karnal district also, where tube-well irrigation has ignited an agricultural revolution, cotton acreage has increased manifold. In the *bet* areas along the Sutlej river, where soils remain sufficiently wet and yield good crops even without irrigation, the increase in cotton area is equally spectacular.

In marked contrast to the areas mentioned above, cotton acreage has declined in large parts of the Gurdaspur, Amritsar, Kapurthala, Hoshiarpur and Kangra districts. The most significant decrease has taken place in those areas where water-logging conditions have developed and *kallar* soils have become extensive.

The overall large increase in cotton acreage in Punjab is attributed, apart from extension in irrigation and reclamation of wastelands, to continuing high prices of cotton; increasing demand for cotton, particularly of long staple, in response to the expanding cotton textile industry in the country; and the role of the state in planning for increased cotton acreage in view of the

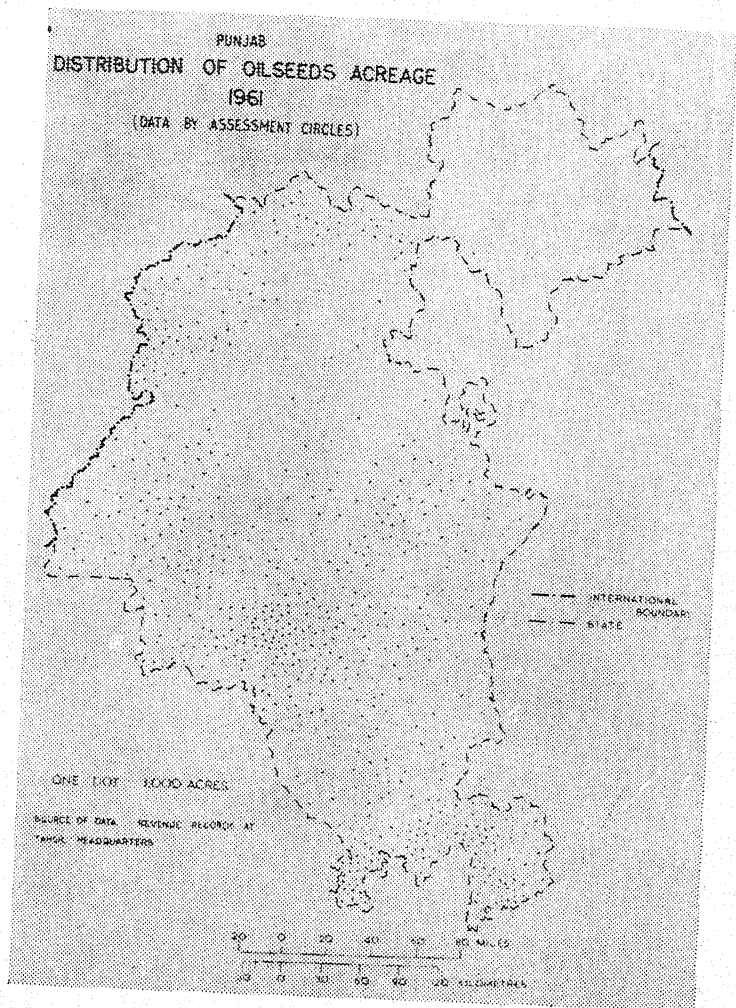


MAP 40

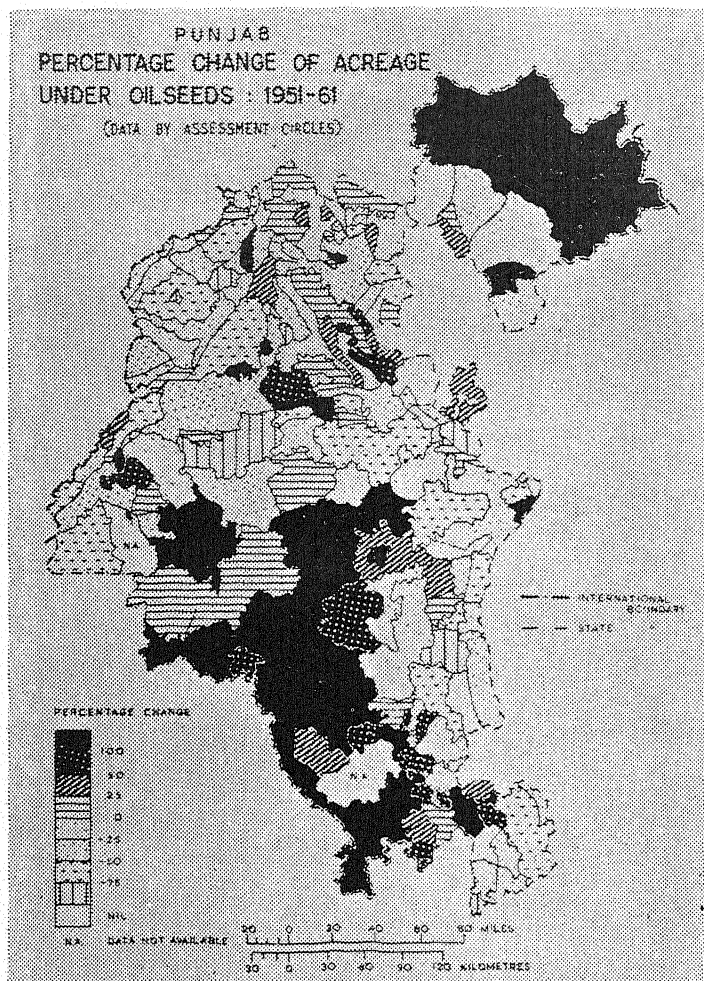
important cotton growing areas having been left in West Pakistan. There is still large scope for extending the cotton area in parts of the Hissar, Bhatinda and Sangrur districts where irrigational facilities need to be augmented.

Oilseeds

Some oilseed crop or the other is grown in each crop season in Punjab. Whereas groundnut cultivation is done in the *kharif* season, mustard, linseed, etc., are the *rabi* crops. Oilseeds are grown as independent crops as well as with other crops by inter-culture methods, but mostly in the latter manner. Oilseeds



MAP 41



MAP 42

are generally crops of light soils and relatively dry areas. However, specific requirements of various crops differ in degrees.

Oilseed crops of the *rabi* season are sown by inter-culture with wheat and gram in less dry area and independently in dry areas. The *kharif* oilseeds are sown along with cotton and maize. Oilseeds are grown both as cash crops and for local consumption. With the exception of groundnuts, the acreage

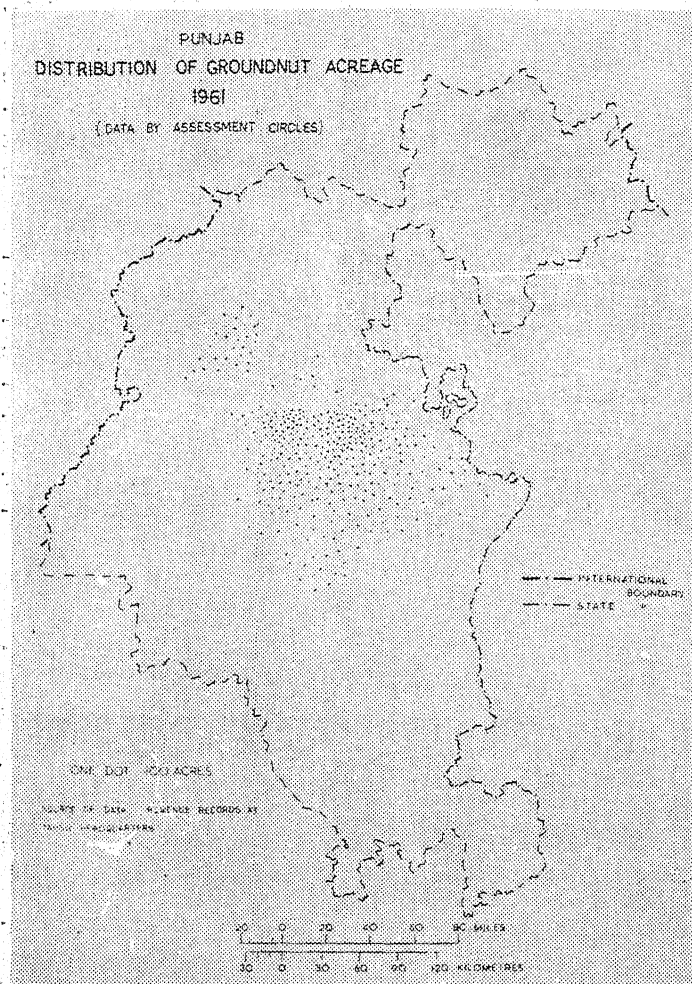
under diverse oilseeds is largely concentrated in the semi-dry southern and south-western zone of Punjab (Map 41). In the Ferozepur, Hissar, Bhatinda and Sangrur districts, oilseeds are next only to cotton as commercial crops. There is fair distribution of these crops in the Amritsar district also. In the Bist *doab*, wet *khadars* and the hilly areas with heavy rainfall oilseeds acreage is insignificant.

The total area under oilseeds (excepting groundnuts) increased only by about 20 per cent during 1951-61. Whereas it has more than doubled in the newly reclaimed areas of the Yamuna-Sutlej divide, it has suffered serious decline practically everywhere else (Map 42). The decline is significant in areas where water-table has come close to the earth's surface. Although percentage-wise increase in oilseeds acreage in Lahaul & Spiti area is very high, yet the actual acreage involved is small. Wherever conditions permit, oilseeds are being replaced by more remunerative crops.

Groundnut

With only about .8 per cent of the total cropped area, groundnut cultivation, which is done in *kharif* season, does not figure as important in Punjab's agricultural land-use. However, in some local areas it is not only by far the most important cash crop but even the first ranking crop. The main area of concentration of groundnut cultivation is in the Samrala and Ludhiana tahsils of the Ludhiana district and adjoining areas of the Jullundur, Ambala, Patiala and Sangrur districts (Map 43).

Khanna town which is the chief marketing centre for groundnut has experienced spectacular growth in recent years in marked correspondence with increase in the acreage of this crop. There is another isolated pocket in the Kapurthala district where this crop emerges as quite important. In all cases, the distributional pattern is strongly correlated with: (i) loamy sand to sandy loam soils; and (ii) moderate rainfall generally exceeding 30 inches. These soils are not only conducive to easy penetration of the roots of the crop into the ground but also provide excellent drainage. Heavier soils if well tilled and of good structure may give higher yields, but clayey soils or in fact any other soils which



MAP 43

tend to form a hard surface are not favourable for groundnut cultivation. The soils should be well drained, as too high a moisture content will result in rotting. In large parts of the foot-hill zone of the Ambala, Hoshiarpur and Gurdaspur districts where soils are porous, rainfall ranges between 35 and 40 inches, and sunshine is abundant throughout the growth period of the plant, conditions are favourable for the extension of groundnut acreage.

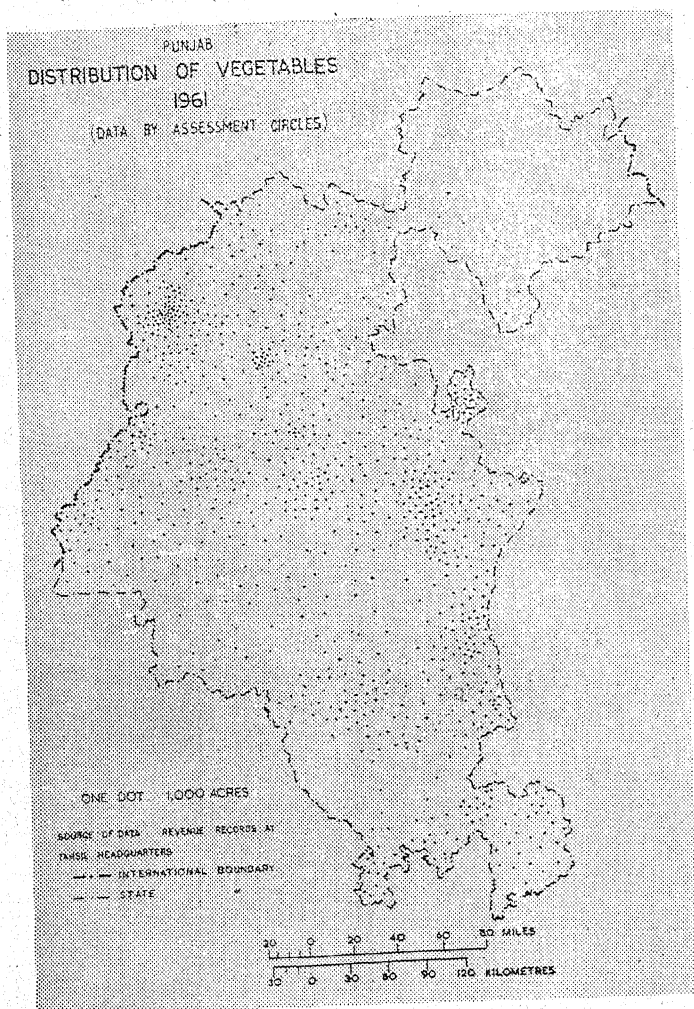
There are several areas in the southern and south-western Punjab where sandy loams and loamy sands predominate, yet they are without any groundnut cultivation due chiefly to meagre and variable rainfall. Not only does the groundnut plant require moderately large amount of water-supply but also prefers its regular distribution over the growing period. A relatively dry period at the time of ripening is, however, necessary.

The groundnut crop is only a recent addition to Punjab's agricultural scene, mostly since the Second World War. During this period its price has shown persistent increase, and also its consumption in the form of vegetable *ghee* and its use as an oil increased manifold. During the last decade the cultivation of this crop has received great stimulus, its area increasing from 98,000 acres in 1950-51 to 189,000 acres in 1961-62. Its cultivation should be further extended as it has high food value. Because of its content of vitamin B, the groundnut can be an important item in our food. The groundnut cake is an excellent livestock feed. The groundnut is a leguminous crop and thus adds a lot of humus to the soil.

Vegetables

The vegetable crops cover an insignificant fraction of the state's cropped land. Till recently their consumption was practically confined to the relatively well-off people of towns and cities. During the last few years the use of vegetables has increased in villages, but a very large part of the total product still finds its way to urban markets.

As the vegetables are perishable and as yet there are no adequate facilities for preserving them, they are grown either in the vicinity of towns or in areas connected with the markets by railways. The clusters of dots around urban places, such as Amritsar, Jullundur, Ludhiana, Ambala, and Karnal, bring out this fact very clearly (Map 44). Certain communities in Malerkotla are traditional truck farmers, supplying vegetables to other towns in the state. Simla district has also made significant progress in vegetable cultivation in recent years. The fast growth of the Delhi metropolitan area is making a great impact on the land-use of areas connected with it by rail. The zone

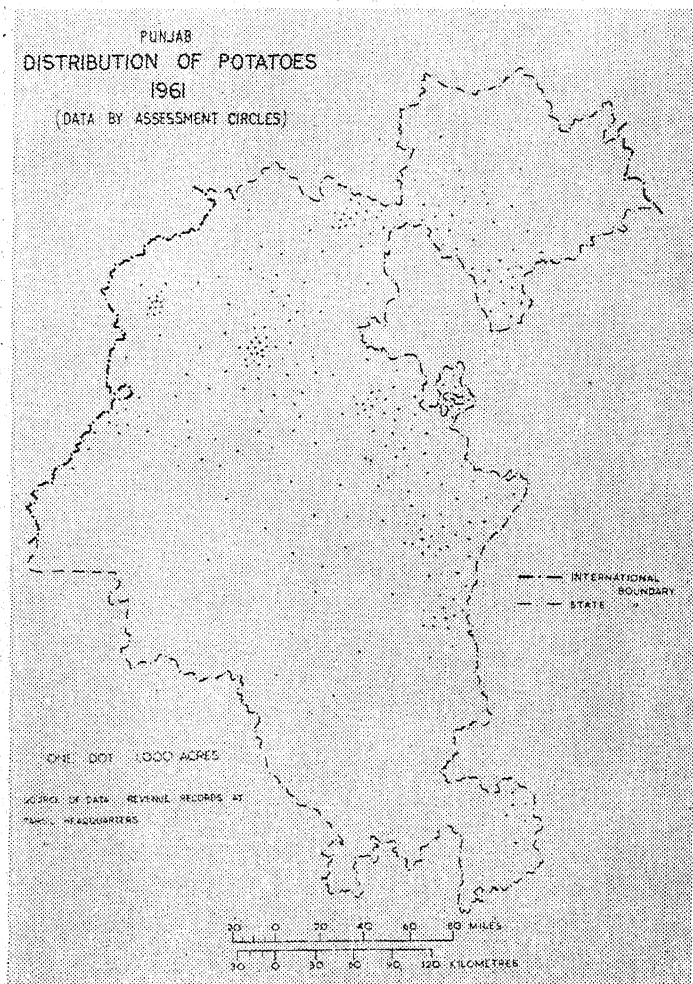


MAP 44

from Ambala to Delhi along the rail route is increasingly becoming important for truck-farming. With increasing urbanisation in the state and adjacent areas, vegetable acreage is bound to increase in future.

Potatoes

Like other vegetables, potato acreage is minor both in absolute and relative terms. However, in some local areas it does emerge as a valuable cash crop. Potato cultivation is practically confined to the comparatively moist northern plain and mountainous



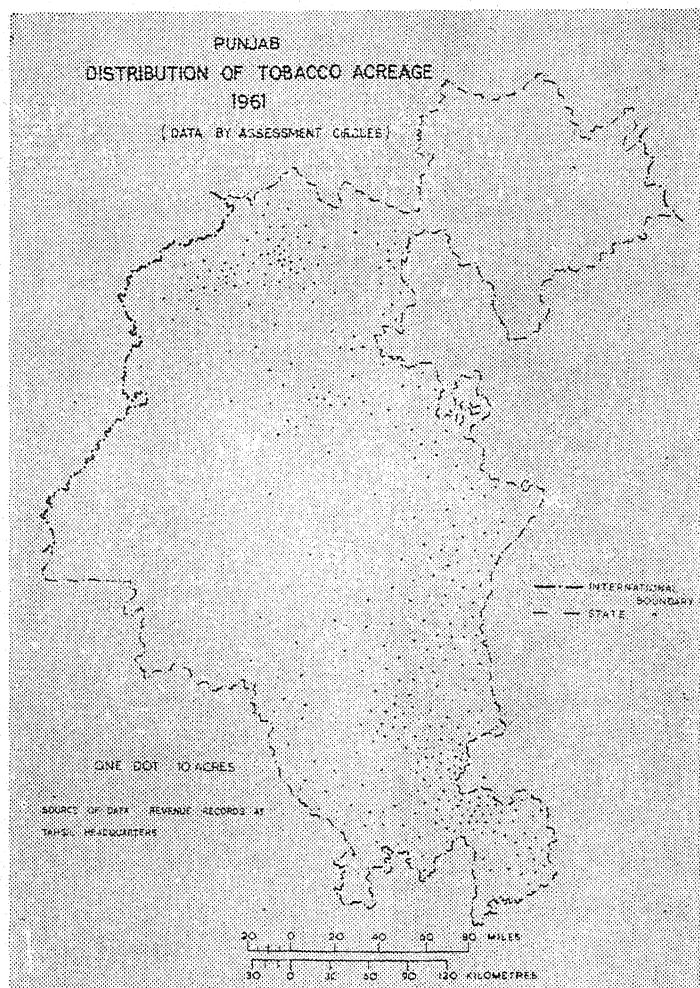
area (Map 45). Since the crop requires watering at certain intervals, supplementary irrigation is necessary everywhere. Two crops of potatoes in a year are obtained in some plain areas. However, whenever frost occurs it proves harmful to the winter crop. Although cool, humid conditions are favourable to the growth of potatoes continued high atmospheric humidity under such conditions is conducive to the development of blights. Many kinds of soil favour potato cultivation, but they must permit deep tillage and provide good drainage. Fine sandy loams, silt loams and loams have generally proved good for the crop which requires heavy manuring.

Within the northern plain potato acreage is concentrated around large cities such as Amritsar and Jullundur. However, scattered potato cultivation is characteristic of the Jullundur, Hoshiarpur, Ambala and Karnal districts among which Jullundur leads. The Kangra district is the second leading producer of potatoes. In the plains potato cultivation is generally characteristic of small land-holdings particularly of cultivators of the Saini community. However, in recent years it has become equally important with farmers of other communities also. It is among the most remunerative crops. The area under potato cultivation has increased from 15,000 acres in 1950-51 to 32,000 in 1961-62.

Throughout the foot-hill zone where soils are porous, rainfall moderately heavy and where possibilities of developing well irrigation exist, there is a great scope for extending area under potato cultivation.

Tobacco

Tobacco cultivation covers only about 4,000 acres in Punjab. It is largely concentrated in eastern and northern Punjab Plain where the soils are deep, well drained and of good physical structures (Map 46). Since the crop requires frequent watering, its cultivation is done with the help of irrigation mostly from the wells. The concentration of tobacco acreage is particularly great in the eastern zone of the Punjab Plain where there are no religious prejudices to either smoking or growing tobacco. In the northern zone, tobacco cultivation is confined to the Saini



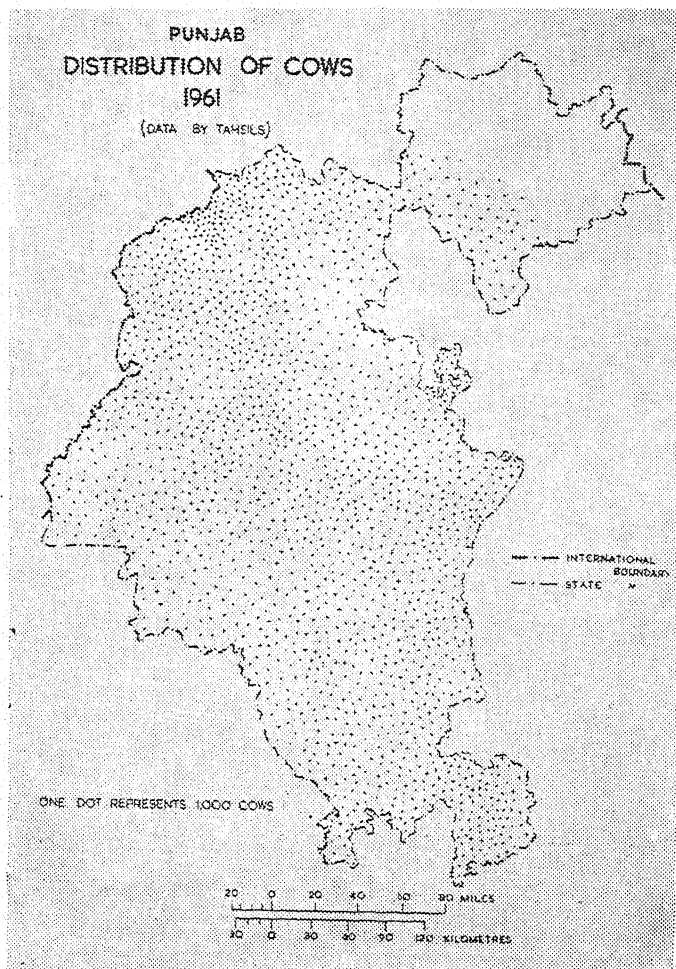
MAP 46

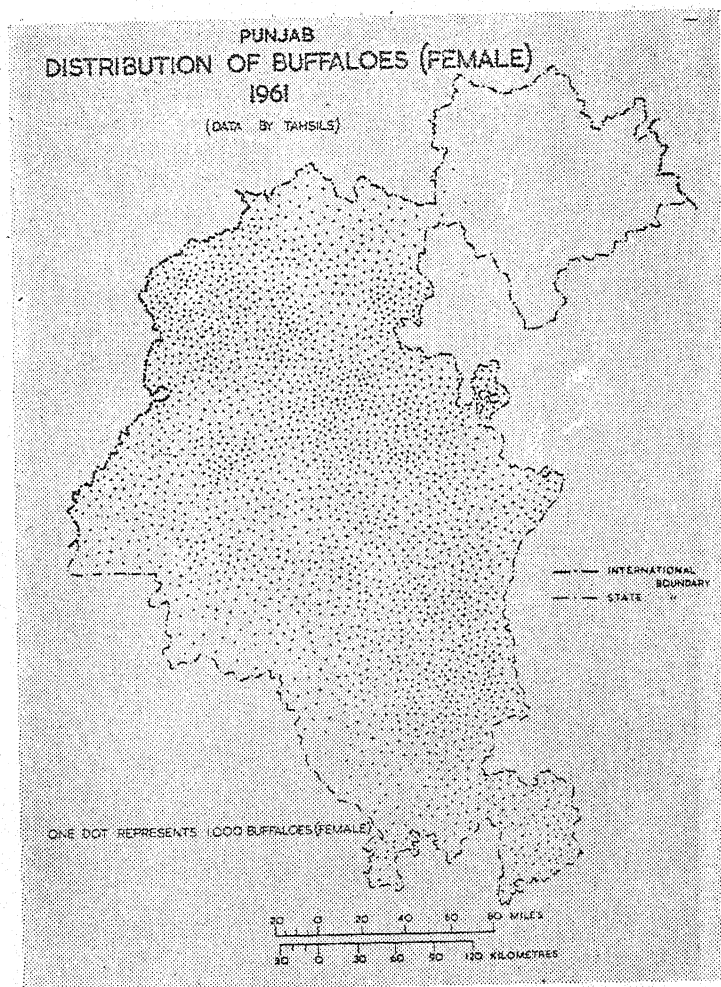
community and the Rajputs. Invariably, Sikh Jats do not grow tobacco because of a religious taboo against smoking and its cultivation. In fact, they do not even touch it.

Fodder Crops

Dry stalk of a number of crops—such as maize, jowar, bajra, wheat, gram, etc.—is used as fodder. The pressure on farmland

for good production is so great that only the minimum proportion of the cultivated land is used exclusively for growing fodder crops. There are practically no grazing lands in the intensively cultivated plains of the state. After the crops have been harvested, the cattle are let free in the fields and allowed to graze on stubble. The cattle are far from being properly fed and raised.



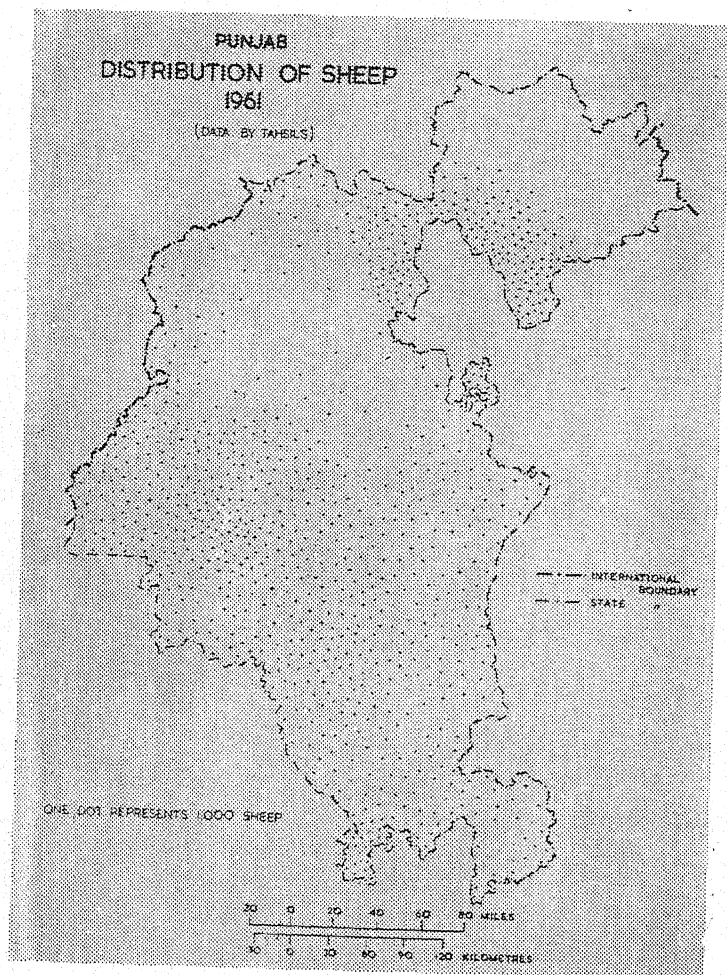


MAP 48

Thus, in spite of a large cattle population, there is hardly any animal husbandry. However, conditions in other states are still worse.

Although Punjab devotes the largest proportion of its farmland to fodder crops in the country, yet it is only a very small fraction of the total cropped land. The fodder crops commonly grown

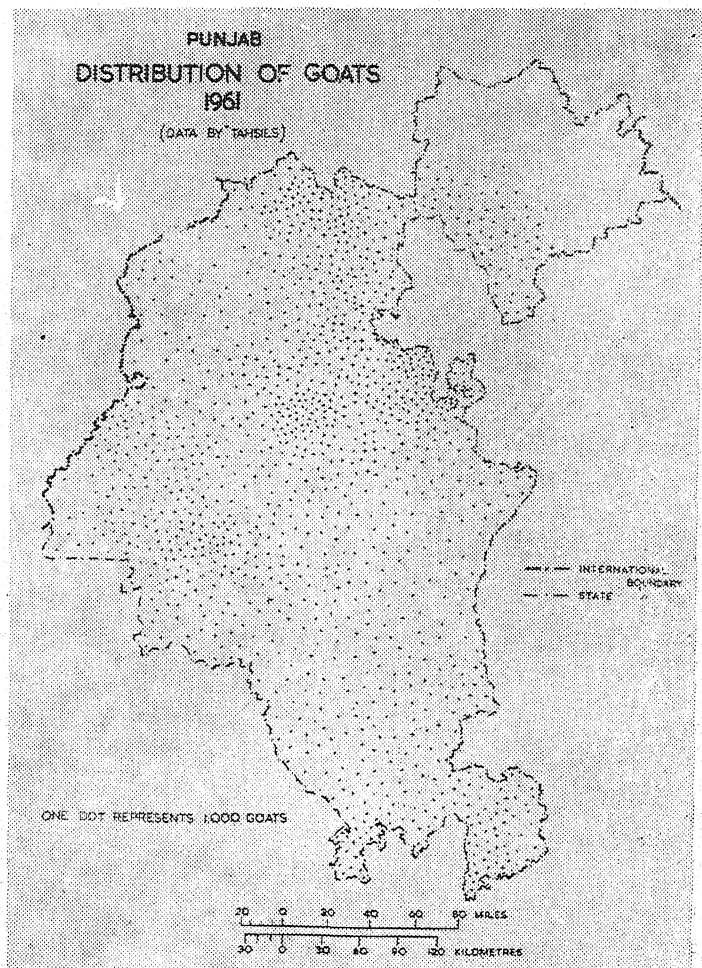
include *barseem*, *maithe*, etc., in irrigated areas, and jowar, maize, barley, wheat-gram, etc., in unirrigated lands. Unfortunately no detailed statistics are available to enable analysis of regional differences in the relative importance of various fodder crops in the state.



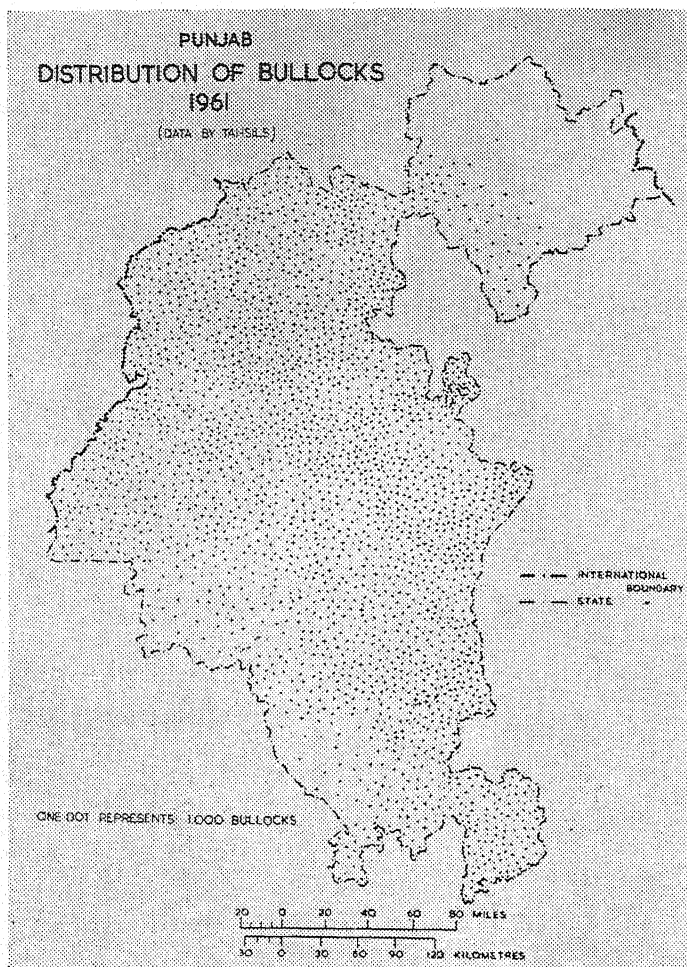
MAP 49

Livestock

India has the largest but one of the least productive, livestock population in the world. Within India, Punjab holds a special position in that its cattle are relatively of superior breed and numerically large. The better quality of livestock is maintained with the help of fodder crops and the use of feed grains.



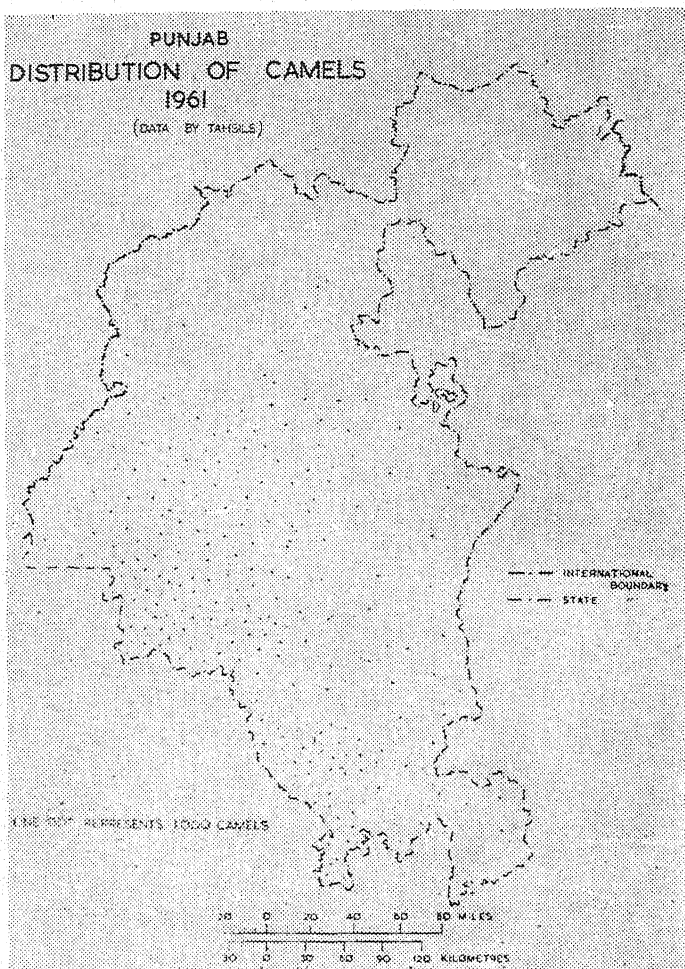
MAP 50



MAP 51

However, with the human population experiencing vigorous growth, the area under fodder crops is being encroached upon by food crops and the use of grain as feed is disappearing. Concentrates are too expensive to be used. As a result, the quality of livestock has started deteriorating. This is particularly true of the unirrigated small land-holdings. In areas irrigated by wells and tube-wells, on the other hand, the same small field may

give four to five cuttings of green fodder within a year. But even here the use of grain and concentrates for feeding the cattle is lacking. It is only in the canal irrigated areas specially those of the Rohtak, Hissar, Sangrur, Bhatinda and Ferozepur districts, where land holdings are large, that the quality of draft as well as dairy cattle is reasonably good. In Punjab as a whole there are



about 280 heads of livestock per square mile of land. However, the distribution of various types of cattle is very uneven as illustrated by Maps 47 to 52. In each case the distributional pattern is related to physical environment, utility and traditional association of the cattle.

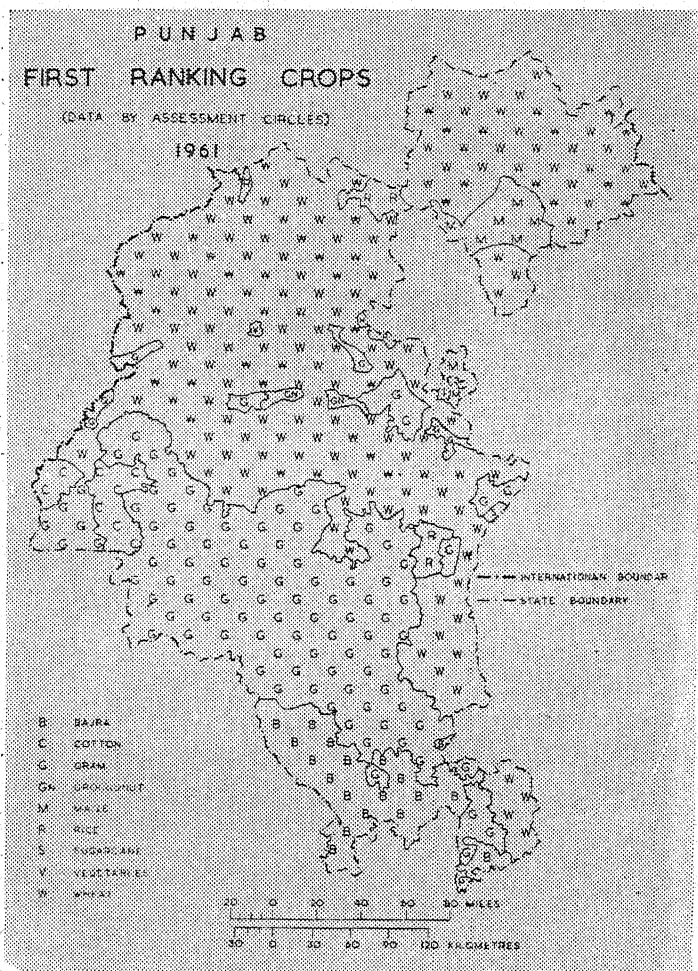
Ranking of Crops

A study of ranking of crops is necessary for an understanding of their relative importance (in terms of acreage) in the areas they are grown. For this purpose, proportions of areas covered by various crops to total cropped land in each assessment circle are arranged in order, and the four top ranking crops thus obtained are plotted on four separate maps, each map bringing out the spatial pattern of crops of a particular rank (Map 53 to 56). A perusal of these maps reveals that the distributional pattern of the first ranking crops is the most simplified, but it becomes progressively complex for the second, third and fourth ranking crops in that order. Another point which emerges in these maps is that the number of crops in the first rank is the lowest and it increases with the lowering of the rank. Whereas the first ranking crops are nine, the fourth ranking crops are fourteen. Finally, among the four top ranking crops, the cereals cover by far the largest acreage. It is only in the third and fourth ranks that cash crops occupy area worthy of mention. But even this is restricted to certain regions only.

The First Ranking Crops

The crops which rank first in one or more assessment circles are: wheat, gram, bajra, maize, rice, cotton, groundnut, sugarcane and vegetables. Wheat as a first ranking crop is the most extensively grown, covering practically the whole of the northern and eastern Punjab (Map 53). This is largely because of the favourable physical conditions (winter showers, loamy soils and long frost-free season) for wheat cultivation prevailing in the region; the superiority of wheat as a food crop among all the cereal crops; and the traditional emphasis on food crops in the agricultural land-use of the entire state so as to achieve self-sufficiency in food production.

Within the northern and eastern Punjab, there are a few discontinuities in the contiguity of areas in which wheat ranks first.



MAP 53

For example, in parts of the Kulu tahsil and in the Simla district maize is the first crop. In a couple of assessment circles of Palampur tahsil rice ranks first. In the Jullundur assessment circle, which adjoins the city, vegetables exceed all other crops in acreage. In one of the hilly circles of the Una tahsil, and in parts of the Ruper, Kharar, and Jagadhari tahsils gram comes to the

forefront. In two assessment circles of the Ludhiana district where sandy loams and loamy sands predominate, groundnut is the top ranking crop. In a circle near Jagadhari where there is a sugar mill, sugarcane is the chief crop. In some of the newly reclaimed and irrigated areas of Karnal rice is the most popular crop.

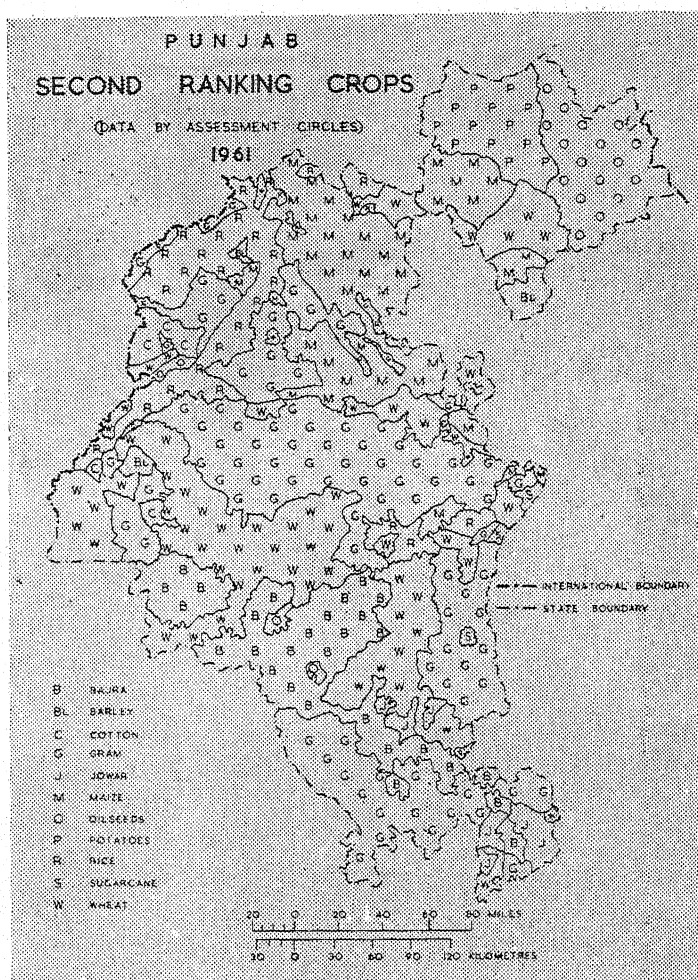
In the southern and south-western Punjab Plain where relatively dry conditions prevail and where the soils are predominantly sandy loams bajra and gram respectively are the dominant crops. In a small area of the canal irrigated Ferozepur district, however, cotton ranks first. The dominance of gram in some of the canal irrigated areas strikes strange at first thought. As mentioned earlier, water in the canals is inadequate for covering the entire sown area so that unirrigated crops account for a considerable proportion of the total cropped land. Bajra acreage is concentrated in the still drier and sandier parts of the southern Punjab. But over 90 per cent of the area of the state wheat and gram are the top ranking crops.

The Second Ranking Crops

Map 54, showing the distribution of second ranking crops which are eleven in all, presents a far less simplified pattern than Map 53. In the canal irrigated and partly water-logged Amritsar district, the floodplain of the Beas river in the Bist *doab*, the *bet* areas of the Ferozepur district, and the lowlands along the Markanda stream in the Karnal district, rice holds second position.

In the mountainous districts of Kangra and Simla where maize is the first ranking crop wheat ranks second and *vice versa*. Also, in the sub-hilly zone of the Hoshiarpur district maize is the second ranking crop. In the Jullundur, Ludhiana, Ambala and parts of the Sangrur, Bhatinda, Karnal and Rohtak districts, gram is second only to wheat. In most of these areas gram follows maize or jowar in the rotation system and is grown in mixture with wheat, oilseeds, barley or independently.

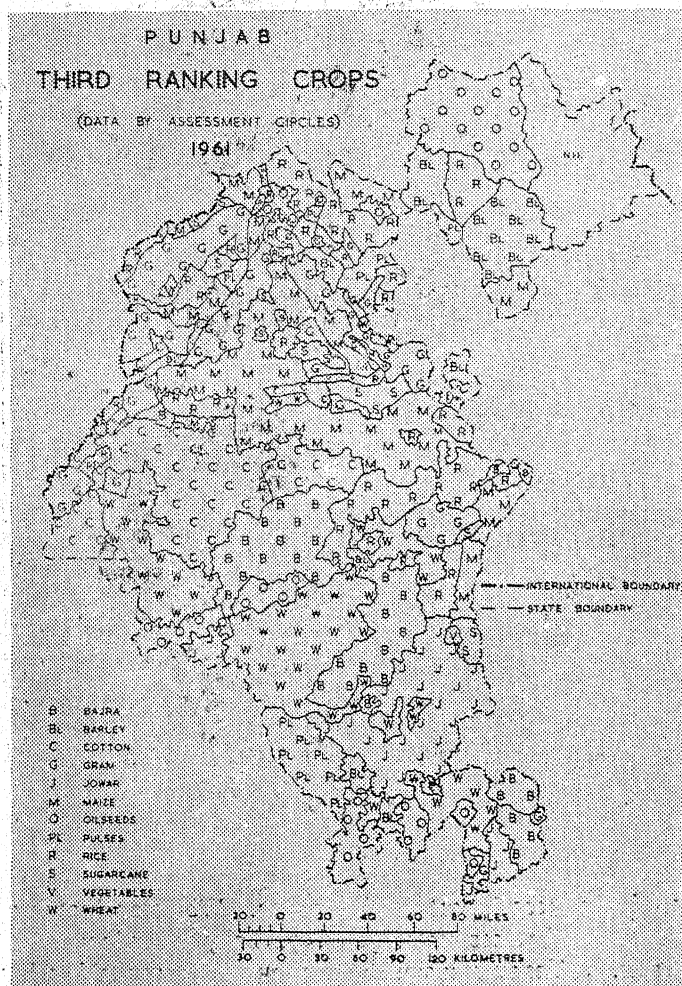
In several of the canal irrigated areas of the Ferozepur Bhatinda, and Sangrur districts where gram holds first rank



MAP 54

wheat is the second most dominant crop. Whereas wheat is an irrigated crop in these areas, gram is generally grown in unirrigated tracts. Whenever adequate water supply is available wheat replaces gram. In the area adjoining Panipat where there is a sugar mill, sugarcane occupies second place.

In the Mahendragarh and parts of the Gurgaon and Hissar districts, where because of semi-arid conditions bajra is the top ranking crop, gram occupies second place. In some parts of the Gurgaon district, however, jowar is the second ranking crop.



The Third Ranking Corps

The distribution of third ranking crops presents a more fragmented pattern than that of the second ranking crops (Map 55). With a few notable exceptions, cereal crops dominate the third ranking crops. In the Kulu valley and the Simla district barley holds third rank. In other parts of the Kangra district, and some of the *bet* areas of the Beas and Ravi rivers rice is the third most dominant crop. In large sections of the Amritsar, Gurdaspur and Kapurthala districts gram is the third ranking crop, while maize holds that position in the Jullundur and Ludhiana districts, western half of the Ambala district, and eastern parts of the Karnal district. In parts of the Rupar and Nawanshahr tahsils and the *khadar* tract near Panipat sugarcane holds third rank. Vegetables rank third among the crops grown in the Panipat circle.

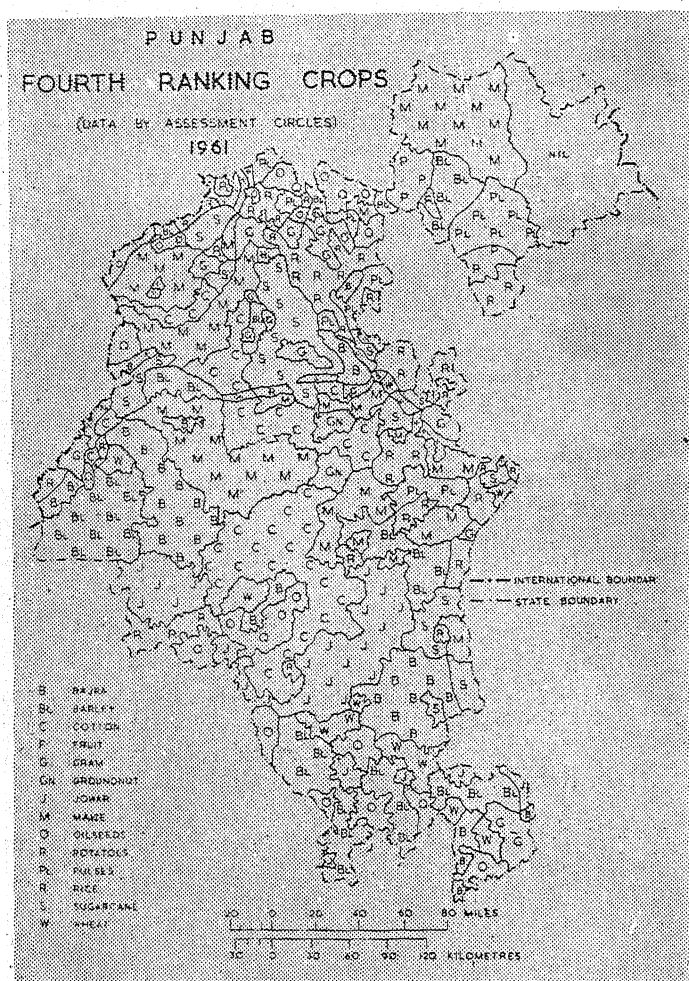
In an extensive area consisting of parts of the Ferozepur, Bhatinda and Sangrur districts where canal irrigation has been available for a long time cotton is the third ranking crop. It is the single largest area where a cash crop dominates the land-use. The less irrigated areas of the latter two districts on the other hand are dominated by bajra as the third most important crop. In the Rohtak district jowar, in the arid areas of the southern Hissar pulses, in the Mahendragarh district oilseeds and in Gurgaon both jowar and bajra are the third ranking crops.

The Fourth Ranking Crops

The distribution of fourth ranking crops, which are as many as 14, presents a rather complex pattern (Map 56). Although food crops still dominate in many parts of the state, cash crops hold fourth rank in several areas.

In parts of the Amritsar, Kapurthala, Ferozepur, Sangrur and Patiala districts maize occupies fourth place. Whereas in a few assessment circles of the Kangra district potatoes are important, in the remaining areas pulses, rice, oilseeds and gram dominate as fourth ranking crops. In parts of the Gurdaspur, Hoshiarpur, Jullundur, Ambala and Rohtak districts and in the circles adjoining Panipat sugarcane is the fourth crop. Similarly,

cotton dominates the agricultural landscape of several areas including parts of the Amritsar, Jullundur, Ludhiana, Patiala, Sangrur, Bhatinda and Hissar districts where irrigation facilities exist. In the Bhatinda, Faridkot, Gohana, and Rohtak tahsils bajra still persists, while in Fazilka, Muktsar, Bhiwani, Narnaul, Ballabhgarh and Gurgaon tahsils barley is the fourth ranking



crop. Jowar holds the same position in Sirsa, Kaithal and Nirwana tahsils. In the lowlands along the Ghaggar river in the Naili circle of the Sirsa tahsil rice is the fourth most important crop.

CONCLUSIONS

The fifty-six maps based mostly on detailed data by assessment circles, included in this study, clearly bring out variations, both at local and regional levels, in general utilisation of land as well as patterns of use of the cropped land. These variations remain hidden in the statistical averages for large areal units such as the district and the state. A very large proportion of the physical area being already under the plough, there is no scope for appreciable extension of cultivated land. The frontiers of settlement have already reached the maximum limits. Whatever gains in cultivated area have been made possible by reclamation of wasteland and introduction of irrigation have been neutralised to a considerable extent by losses resulting from encroachment on farmland for other purposes and the development of water-logging in several areas of the state. Moreover, the land which is currently lost to agriculture is usually of high grade, while that being reclaimed is of low to medium quality. The staggering increase in population in recent years has made its own impact in this regard. Thus any plan for increased farm production has to depend mainly upon intensification and diversification of agriculture. The development of poultry and piggery on every farm, even on a modest scale, will go a long way in improving the quality and quantity of food supply. There is an urgent need of a land-utilisation survey which may become the basis of future land-use planning whereby the growing demand on land for non-agricultural purposes may be met but without encroachment on good farmland.

The proportion of sown area which is double cropped is still rather low. Even in the canal irrigated areas single cropping is the general rule, indicating inadequacy of water in canals for both the crop seasons as also for all crops within a crop season. In view of the irregularity, variability and concentration in a short period of the monsoon rains, the development of irrigation,

even in areas which apparently have adequate rainfall, is a pre-requisite for the stabilization of agricultural economy. Whereas there is need to develop well and tube-well irrigation in the more rainy northern plain to the maximum limit, it is equally necessary to spare every drop of canal water for the semi-arid southern and south-western Punjab Plain. This will help not only in increasing the proportion of double cropped area but also the yields of crops already being sown.

The fact that about 75 per cent of the cropped land is devoted to food crops and that all the four top ranking crops in about 90 per cent of the state's area are food crops indicates that: (i) farming in Punjab is still of a predominantly subsistence type; and (ii) the severe pressure of population requires the devotion of a large proportion of the cropped land to food crops. However, compared to several other states of India, Punjab's agriculture is characterised by a much higher degree of commercialisation. Be it noted also that some food crops—such as wheat, rice and gram—are grown as both food and cash crops. Thus the actual degree of cash crop farming is somewhat higher than is apparent from crop acreages.

Analysis of the distributional pattern of various crops reveals that not only do the crops show adjustment to physical environment but also respond equally well to cultural and economic factors. Among the physical factors the most critical are: terrain, soil, and water-supply. Temperature is a critical factor in the mountainous areas, but not so much in the plains.

Although acreage of all the major food crops and several of the non-food crops increased during 1951-61, the increase was proportionately far greater in the acreage of cash crops. Much of the increase in acreage of different crops took place in areas where: (i) wastelands were reclaimed; and (ii) canal and tube-well irrigation was introduced which extended the land under double cropping. Apart from bringing additional new land under different crops, the recent development of irrigation has also brought about significant changes in the existing crop pattern. As a result, minor food crops, pulses and minor oilseeds have been replaced to an appreciable extent by major food or more

remunerative cash crops. Changes of far reaching consequences have also taken place in the crop patterns of recently water-logged areas where rice has assumed far greater importance than ever before. No less potent in these changes, however, have been the human and economic factors. The role of state as a planning agency has been equally instrumental in increasing area under several vital crops. Whereas the acreage of wheat, rice, maize, gram, sugarcane, groundnut, mustard and cotton increased substantially during the decade, that of bajra, barley, pulses and minor oilseeds decreased. The greatest increases in most of the crops took place in the Yamuna-Sutlej divide, particularly in the north-east to south-west extending central belt where new canal irrigation has been introduced during the decade. The foot-hill zone of the Ambala, Hoshiarpur, and Gurdaspur districts, hilly areas of the Kangra district, and the southern districts of Mahendragarh and Gurgaon have, by comparison, experienced only minor changes.

This paper will be followed by another which will deal with the agricultural regions of Punjab in each of which a few selected villages and farm units will be studied in detail so that a very close look is possible at the patterns of land-use and recent changes therein. This study, it is hoped, will provide a basis for future planning of agricultural development in the state.

